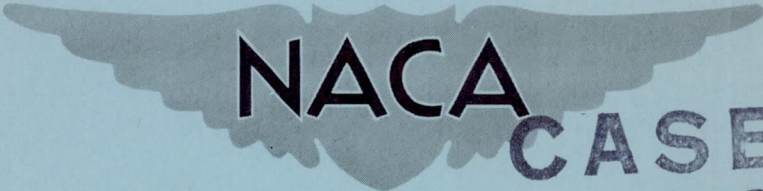


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RESEARCH MEMORANDUM

INVESTIGATION AT HIGH SUBSONIC SPEEDS OF THE PRESSURE
DISTRIBUTIONS ON A 45° SWEEPBACK VERTICAL TAIL IN
SIDESLIP WITH A 45° SWEEPBACK HORIZONTAL TAIL
MOUNTED AT 50-PERCENT AND 100-PERCENT
VERTICAL-TAIL SPAN

By Harleth G. Wiley and William C. Moseley, Jr.

Langley Aeronautical Laboratory
Langley Field, Va.

CLASSIFIED DOCUMENT

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**NATIONAL ADVISORY COMMITTEE
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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

RESEARCH MEMORANDUM

INVESTIGATION AT HIGH SUBSONIC SPEEDS OF THE PRESSURE
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SIDESLIP WITH A 45° SWEPTBACK HORIZONTAL TAIL
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VERTICAL-TAIL SPAN

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SUMMARY

An investigation was made in the Langley high-speed 7- by 10-foot tunnel at high subsonic speeds and several angles of attack of the chordwise pressure distributions in sideslip at six span stations on a 45° sweptback, untapered, vertical tail with a 45° sweptback horizontal tail mounted at 50-percent and 100-percent vertical-tail span. The vertical and horizontal tails had NACA 65A010 airfoils normal to the leading edge and had aspect ratios of 2.0 and 4.0, respectively.

Results indicated that at sideslip angles up to about 8° , the loading on the vertical tail was slightly increased with the horizontal tail mounted at the tip of the vertical tail. Above an angle of sideslip of about 8° , horizontal-tail locations of 50- and 100-percent vertical-tail span decreased the span loading on the vertical tail in the immediate vicinity of the horizontal tail.

INTRODUCTION

The National Advisory Committee for Aeronautics has undertaken a comprehensive research program to study the effects of design variables and flight attitudes on the stability contributions of and the aerodynamic loadings on tail assemblies (refs. 1, 2, and 3). As part of the general research program, tests were made at high-subsonic Mach numbers of the effects of horizontal-tail height on the aerodynamic loadings in sideslip on the vertical tail of a 45° sweptback, untapered tail assembly. Chordwise pressure distributions on a vertical tail with and

without a horizontal tail mounted on the fuselage center line were reported in reference 4.

The present investigation was made to determine the aerodynamic loadings in sideslip on an untapered 45° sweptback vertical tail mounted on a fuselage with a 45° sweptback horizontal tail located at 50- and 100-percent vertical-tail span. The vertical and horizontal tails had NACA 65A010 airfoils measured perpendicular to the leading edges and aspect ratios of 2.0 and 4.0, respectively.

Chordwise pressure distributions were obtained at six stations along the span of the vertical tail of each tail assembly. Tests were made at angles of attack of 0° , 4° , and 12° , through a sideslip range of -2° to 23° and over a Mach number range of 0.60 to 0.95. Reynolds number for the tests, based on the mean aerodynamic chord of the vertical tail, varied with Mach number from about 1.9×10^6 to 2.4×10^6 .

COEFFICIENTS AND SYMBOLS

The results of this paper are referred to the standard body axes as shown in figure 1 and the coefficients and symbols used are defined as follows:

c_n	section normal-force coefficient of the vertical tail, n/qc
c_m	section moment coefficient of the vertical tail referred to $0.25c$, m/qc^2
C_N	normal-force coefficient of the vertical tail, $\sum (c_{n1} b'_1 c_1 + \dots + c_{n6} b'_6 c_6) \frac{1}{S}$
C_B	root bending-moment coefficient of the vertical tail about intersection of vertical tail and fuselage, $\sum (c_{n1} b'_1 l_1 c_1 + \dots + c_{n6} b'_6 l_6 c_6) \frac{1}{bS}$
P	pressure coefficient, $\frac{p_l - p_o}{q}$
p_l	local static pressure, lb/sq ft
p_o	free-stream static pressure, lb/sq ft
q	free-stream dynamic pressure, $\frac{\rho}{2} V^2$, lb/sq ft

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ρ	mass density of air, slugs/cu ft
V	free-stream velocity, ft/sec
m	section moment
M	Mach number
n	section normal force
R	Reynolds number
α	angle of attack, deg
β	angle of sideslip, deg
$\Delta\beta$	change of angle of sideslip due to vertical-tail load, deg
S	exposed area of the vertical tail, sq ft
c	local chord of vertical tail, ft
$\bar{c}$	mean aerodynamic chord of vertical tail, ft
b_v	span of vertical tail (measured from center line of fuselage to tip of vertical tail), ft
b	exposed span of vertical tail (measured from intersection of fuselage and vertical tail to tip of vertical tail), ft
b'	exposed local span segment, ft
l	distance from intersection of fuselage and vertical tail to centroid of exposed local span segment, ft
z	vertical distance measured along z-axis, in.

Numerical subscripts denote span station.

MODEL AND APPARATUS

A drawing of the models used in the investigation is presented in figure 2. Photographs of the models mounted on the sting in the Langley high-speed 7- by 10-foot tunnel with the vertical tail mounted in a horizontal plane are shown in figure 3.

The untapered 45° sweptback vertical and horizontal tails had NACA 65A010 airfoils normal to the leading edge and aspect ratios of 2.0 and 4.0, respectively. Tests were made with models having the horizontal tail located at 50- and 100-percent vertical-tail span (figs. 2 and 3). The tail surfaces had steel cores with glass cloth and plastic finish contours. The tail surfaces were mounted on a cylindrical body with an ogival-shaped nose piece (fig. 2).

Pressure tubes were installed in the plastic contour of the vertical tail along constant-percentage chord lines as given in table I. Data were first obtained at the outermost span station (station 1 in fig. 2), the orifices at station 1 were then sealed and new orifices were drilled at the next station (station 2). Thus, by moving progressively inboard, data were obtained for all spanwise stations.

The chordwise pressure distributions were directly photographed on a pressure-diagram machine which produced a film record proportional to the local static pressures imposed at each orifice. The principles of the instrument are more fully described in reference 4. Integrated values of section normal-force and moment coefficients were obtained on an electrical pressure-integrating machine, a more complete description of which is contained in references 4 and 5.

TESTS AND CORRECTIONS

The tests were made in the Langley high-speed 7- by 10-foot tunnel through a Mach number range of 0.60 to 0.95, with corresponding Reynolds numbers, based on the mean aerodynamic chord of the vertical tail, of about 1.9×10^6 to 2.4×10^6 (fig. 4). The tests were made at angles of attack of 0° , 4° , and 12° , through an angle-of-sideslip range of -2° to 23° .

Blockage corrections to Mach number were applied according to the methods of reference 6. Jet-boundary corrections to angle of attack and sideslip were small and were neglected.

Deflection of the sting support system under load contributed a change in angle of sideslip of less than 1 percent of the nominal setting and was neglected.

No corrections to account for aeroelastic distortion of the vertical and horizontal tails under load were made. However, static tests and theoretical computations based on the method of reference 7 were made to determine the change in angle of sideslip $\Delta\beta$ at each station over the span of the vertical tail with a representative experimental loading condition (fig. 5). The static loading used was computed from

the experimental aerodynamic loadings obtained in the tests for each span station of the vertical tail with the horizontal tail mounted at 50-percent vertical-tail span and with the model at 0° angle of attack, 15° angle of sideslip, and a Mach number of 0.95 (fig. 5(a)). For mechanical reasons the static loadings were arbitrarily applied at 27-percent vertical-tail chord. (When computing the distortion due to load by the method of ref. 7, the assumption was made that the vertical tail acted as a simple beam with no restrictions caused by the attachment of the horizontal tail.) Agreement between the measured experimental deflections and the theoretical deflections computed by the method of reference 7 was reasonable (fig. 5(b)), and the deflections are considered representative of the distortion of the vertical tail at high loading conditions. It is believed therefore, that reasonable approximations of the actual deflections of the vertical tail can be obtained for any loading condition presented in this paper by applying the methods of reference 7.

REDUCTION OF DATA

The pressure-integrating machine electrically summarized the product of the pressure differential at each chord station multiplied by "weighted" factors which are proportional to the appropriate portion of the airfoil chord and to its distance from the moment reference to determine section normal force and moment (ref. 4). The "weighting factors" used are presented in table I and are based on the assumption that a square-wave loading with parabolic leading and trailing edges closely approximated the actual chordwise loading (ref. 4). Section normal force and moment were obtained directly in terms of the product of the dynamic pressure q and c_n or c_m for unit chord. The coefficients c_n and c_m were simply obtained by dividing machine results by the factor q .

Normal-force coefficient C_N and bending-moment coefficient C_B were obtained by a numerical integration of the variation of section normal-force coefficient over the exposed vertical-tail span. Values of c_n at each span station were assumed effective over a span segment b' with a moment arm l which extended from the moment reference to the centroid of the span segment (fig. 6) so that:

$$C_N = \sum (c_{n1} b'_1 l c_1 + \dots + c_{n6} b'_6 l c_6) \frac{1}{S}$$

and

$$C_B = \sum (c_{n1} b'_1 l^2 l c_1 + \dots + c_{n6} b'_6 l^2 c_6) \frac{1}{bS}$$

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Diagrams of the chordwise pressure distributions on the vertical tail are presented as photographed by the pressure-diagram machine. On the diagrams the abscissa is the chordwise location of the pressure orifice on the vertical tail and the ordinate is the local static pressure in terms of the dynamic pressure:

$$P = \frac{P_l - P_o}{q}$$

ACCURACY OF DATA

The accuracies of the section aerodynamic characteristics c_n , c_m , and P are direct functions of the mechanical accuracy of the pressure integrating and pressure diagram machines. The data are believed accurate within the following limits:

c_n	± 0.005
c_m	± 0.001
P	± 0.03

PRESENTATION OF DATA AND DISCUSSION

Tabulated values of section normal-force coefficient c_n and section moment coefficient c_m on the vertical tail at six representative span stations are presented in tables II to VIII for models with the horizontal tail at 50-percent and 100-percent vertical-tail span at all angles of attack and sideslip and all Mach numbers investigated.

The spanwise variations of c_n over the vertical tail at representative angles of sideslip are presented in figure 7 for models with the horizontal tail at $0.5b_v$ and $1.0b_v$ at all Mach numbers and angles of attack investigated. Presented in figure 8 are the variations of section-moment coefficient c_m with section normal-force coefficient at five representative vertical-tail span stations for both horizontal-tail locations at 0° angle of attack. The variations of normal-force coefficient C_N and root bending-moment coefficient C_B with β for the vertical tail with horizontal tail located at $0.5b_v$ and $1.0b_v$ are presented in figures 9 and 10, respectively. Diagrams of the chordwise pressure distributions at six span stations on the vertical tail with the horizontal tail located at $0.5b_v$ and $1.0b_v$ are presented in figures 11 to 31 for Mach numbers of 0.60, 0.85, and 0.95, angles of attack of 0° and 12° , and angles of sideslip of 4° , 8° , and 12° .

For angles of sideslip up to about 4° at $\alpha = 0^\circ$, the presence of the horizontal tail at 50-percent vertical-tail span had little effect on the loading on the vertical tail (fig. 7) as compared to the loading on the vertical tail alone (ref. 4). For the same ranges of β and α , location of the horizontal tail at 100-percent vertical-tail span increased the loading on the vertical tail near the tip (fig. 7), an increase apparently due to the end-plate effect of the horizontal tail at these low angles (refs. 2 and 3.) Above $\beta = 8^\circ$, however, the presence of the horizontal tail at either location appreciably decreased the loading on the vertical tail in the general vicinity of the horizontal tail (fig. 7 and ref. 4). (The relative decrease in loading above $\beta = 8^\circ$ for the horizontal tail at $1.0b_v$ is similar to the loss of lift at high angles of attack on a swept wing equipped with an end-plate reported in ref. 8.)

The variation of normal-force coefficient C_N with β was essentially linear for both horizontal-tail heights up to an angle of sideslip of about 8° at all angles of attack investigated (fig. 9). Location of the horizontal tail at $1.0b_v$ resulted in generally greater values of C_N at constant angle of sideslip up to $\beta = 8^\circ$ at all angles of attack than did location at $0.5b_v$.

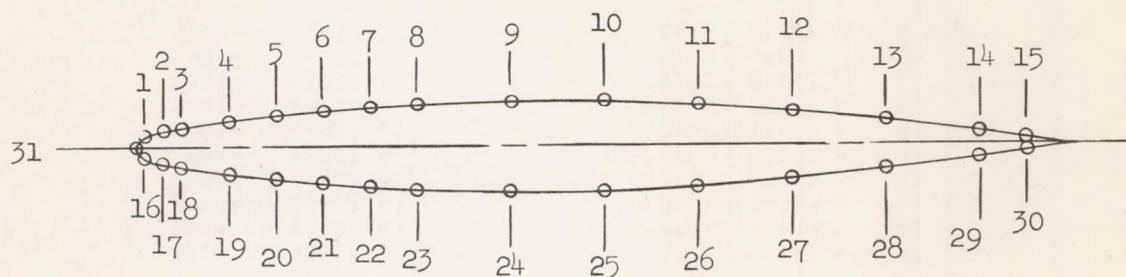
Values of root-bending moment coefficient C_B were somewhat greater for the model with horizontal tail at $1.0b_v$ than at $0.5b_v$ for 0° angle of attack and angles of sideslip up to about 8° at all Mach numbers investigated (fig. 10). Above $\beta = 8^\circ$ and up to about 20° , values of C_B were generally greater for the model with horizontal tail at $0.5b_v$ (fig. 10).

Langley Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., August 20, 1954.

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TABLE I
CHORDWISE PRESSURE-TUBE LOCATIONS AND
CHORDWISE-INTEGRATOR-WEIGHTING FACTORS FOR VERTICAL TAIL



Tube	Chordwise location, percent	Chordwise integrator weightings for	
		c_n	c_m
1 and 16	1	0.2251	0.0961
2 and 17	3	.1750	.0716
3 and 18	5	.3500	.1225
4 and 19	10	.5000	.1364
5 and 20	15	.5000	.0909
6 and 21	20	.5000	.0455
7 and 22	25	.5000	0
8 and 23	30	.7500	-.0852
9 and 24	40	1.0000	-.2727
10 and 25	50	1.0000	-.4545
11 and 26	60	1.0000	-.6364
12 and 27	70	1.0000	-.8182
13 and 28	80	1.0000	-1.0000
14 and 29	90	.6667	-.7550
15 and 30	95	.6667	-.8473
31	0		

TABLE II
SECTION CHARACTERISTICS, STATION 0.931b_v

(a) $\alpha = 0^\circ$.

M	β , deg	Horizontal tail at 0.5b _v		Horizontal tail at 1.0b _v	
		c _n	c _m	c _n	c _m
.60	- 2	.0615	.006	.1585	-.005
.60	0	.0048	.001	.0024	-.003
.60	2	-.0627	-.007	-.1219	-.001
.60	4	-.1350	-.015	-.2329	-.003
.60	6	-.2025	-.018	-.3097	-.002
.60	8	-.2869	.004	-.2694	-.011
.60	12	-.4243	.033	-.2633	-.006
.60	15	-.4605	.036	-.2950	-.001
.60	20	-.4484	.043	-.4425	.030
.60	23	-.4906	.049	-.4486	.031
.80	- 2	.0577	.007	.1247	-.005
.80	0	.0000	.000	-.0025	-.003
.80	2	-.0731	-.009	-.1305	-.001
.80	4	-.1397	-.019	-.2503	-.006
.80	6	-.2104	-.019	-.3184	-.002
.80	8	-.3452	.017	-.2569	-.018
.80	12	-.4525	.037	-.2355	-.006
.80	15	-.4630	.040	-.3118	.002
.80	20	-.4281	.034	-.4579	.026
.80	23	-.4939	.045	-.5080	.033
.85	- 2	.0636	.007	.1298	-.005
.85	0	.0000	.001	.0008	-.003
.85	2	-.0697	-.010	-.1275	-.001
.85	4	-.1348	-.020	-.2475	-.007
.85	6	-.2082	-.029	-.3252	-.014
.85	8	-.3475	.009	-.2641	-.018
.85	12	-.4551	.039	-.2203	-.016
.85	15	-.4467	.035	-.2988	-.002
.85	20	-.4293	.031	-.4700	.024
.85	23	-.4975	.043	-.5409	.035
.90	- 2	.0549	.007	.1324	-.004
.90	0	-.0057	-.001	-.0029	-.002
.90	2	-.0734	-.012	-.1389	-.002
.90	4	-.1446	-.027	-.2663	-.010
.90	6	-.2209	-.040	-.3937	-.020
.90	8	-.3391	.007	-.3059	-.019
.90	12	-.4432	.036	-.2613	-.021
.90	15	-.4289	.030	-.3059	-.008
.90	20	-.4289	.027	-.5075	.026
.95	- 2	.0595	.007	.1298	-.005
.95	0	-.0061	-.002	-.0055	-.001
.95	2	-.0744	-.014	-.1420	-.002
.95	4	-.1379	-.030	-.2745	-.011
.95	6	-.2271	-.046	-.4104	-.021
.95	8	-.3650	-.025	-.5518	.012
.95	12	-.4191	.025	-.3073	-.007
.95	15	-.4205	.020	-.3490	-.010

TABLE II - Continued

SECTION CHARACTERISTICS, STATION 0.931b_v(b) $\alpha = 4^\circ$.

M	β , deg	Horizontal tail at 0.5b _v		Horizontal tail at 1.0b _v	
		c _n	c _m	c _n	c _m
.60	- 2	.0459	.008	.1132	-.004
.60	0	.0000	.002	.0085	-.002
.60	2	-.0567	-.007	-.1047	-.000
.60	4	-.1158	-.015	-.2057	-.002
.60	6	-.1762	-.019	-.2921	.009
.60	8	-.3017	.005	-.2836	.001
.60	12	-.5044	.063	-.2751	-.002
.60	15	-.5310	.062	-.2957	.001
.60	20	-.4344	.049	-.3858	.021
.60	23	-.4827	.054	-.4479	.036
.80	- 2	.0496	.008	.1065	-.004
.80	0	-.0016	.001	-.0057	-.002
.80	2	-.0618	-.009	-.1212	-.001
.80	4	-.1219	-.020	-.2294	-.005
.80	6	-.1943	-.020	-.3080	.008
.80	8	-.3292	.008	-.2826	-.004
.80	12	-.5080	.056	-.2687	-.003
.80	15	-.4520	.040	-.3277	.011
.80	20	-.4089	.038	-.4498	.023
.80	23	-.4682	.047	-.5079	.028
.85	- 2	.0530	.009	.1146	-.004
.85	0	.0000	-.000	-.0069	-.001
.85	2	-.0644	-.011	-.1215	-.001
.85	4	-.1243	-.023	-.2376	-.006
.85	6	-.1993	-.034	-.3124	.010
.85	8	-.3152	-.010	-.2903	-.003
.85	12	-.4758	.051	-.2528	-.006
.85	15	-.4395	.046	-.3254	.011
.85	20	-.4198	.045	-.4713	.021
.85	23	-.4842	.051	-.5232	.030
.90	- 2	.0599	.008	.1144	-.003
.90	0	.0021	-.002	-.0050	-.002
.90	2	-.0627	-.013	-.1281	-.001
.90	4	-.1269	-.028	-.2461	-.007
.90	6	-.2082	-.037	-.3274	.001
.90	8	-.3515	-.007	-.3008	-.001
.90	12	-.4456	.047	-.2677	-.019
.90	15	-.4071	.047	-.3087	.004
.90	20	-.4435	.052	-.4792	.021
.95	- 2	.0440	.007	.1127	-.004
.95	0	.0000	-.002	-.0061	-.002
.95	2	-.0575	-.016	-.1332	-.001
.95	4	-.1218	-.031	-.2527	-.007
.95	6	-.1916	-.045	-.3654	-.017
.95	8	-.3256	-.011	-.3203	-.009
.95	12	-.4271	.033	-.3025	-.013
.95	15	-.3858	.034	-.3196	-.013

TABLE II - Concluded

SECTION CHARACTERISTICS, STATION 0.931b_v(c) $\alpha = 12^\circ$.

M	β , deg	Horizontal tail at 0.5b _v		Horizontal tail at 1.0b _v	
		c _n	c _m	c _n	c _m
.60	- 2	.0472	.015	.0849	-.003
.60	0	.0000	.008	-.0133	-.001
.60	2	-.0472	.001	-.1152	.000
.60	4	-.0992	-.006	-.1928	-.000
.60	6	-.1621	-.011	-.2619	.017
.60	8	-.2807	-.010	-.3250	.030
.60	12	-.4538	.049	-.2571	-.020
.60	15	-.4332	.062	-.2619	-.015
.80	- 2	.0473	.014	.0809	-.003
.80	0	.0016	.006	-.0204	-.001
.80	2	-.0506	-.003	-.1192	-.001
.80	4	-.1060	-.014	-.2123	-.002
.80	6	-.1843	-.019	-.2777	.017
.80	8	-.2952	-.014	-.3438	.033
.80	12	-.4313	.055	-.2842	-.019
.80	15	-.3905	.055	-.2916	-.006
.85	- 2	.0433	.014	.0754	-.004
.85	0	.0000	.005	-.0190	-.001
.85	2	-.0510	-.007	-.1218	-.001
.85	4	-.1088	-.021	-.2208	-.003
.85	6	-.1954	-.025	-.2923	.016
.85	8	-.3164	-.017	-.3479	.032
.85	12	-.4244	.049	-.3053	-.014
.85	15	-.3795	.050	-.2992	-.000
.90	- 2	.0486	.007	.0766	-.003
.90	0	.0043	-.000	-.0251	-.002
.90	2	-.0351	-.014	-.1203	-.001
.90	4	-.0894	-.026	-.2155	-.004
.90	6	-.1846	-.031	-.2979	.018
.90	8	-.3026	-.021	-.3616	.032
.90	12	-.4135	.040	-.3208	-.014
.90	15	-.3634	.041		
.95	- 2	.0462	.011	.0924	-.004
.95	0	-.0027	.004	-.0122	-.002
.95	2	-.0421	-.014	-.1121	-.001
.95	4	-.0937	-.027	-.2113	-.004
.95	6	-.1854	-.030	-.2983	.017
.95	8	-.2872	-.022	-.3574	.024

TABLE III
SECTION CHARACTERISTICS, STATION 0.850b_v

(a) $\alpha = 0^\circ$.

M	β , deg	Horizontal tail at 1.0b _v	
		c _n	c _m
.60	- 2	.0856	.002
.60	0	.0202	.004
.60	2	.1392	.006
.60	4	.2403	.005
.60	6	.3259	.011
.60	8	.3580	.021
.60	12	.4080	.042
.60	15	.4258	.039
.60	20	.4996	.055
.60	23	.5591	.061
.80	- 2	.0946	.001
.80	0	.0192	.004
.80	2	.1459	.006
.80	4	.2533	.003
.80	6	.3422	.004
.80	8	.3583	.019
.80	12	.3831	.038
.80	15	.3927	.035
.80	20	.5330	.061
.80	23	.6139	.070
.85	- 2	.1024	.000
.85	0	.0187	.004
.85	2	.1510	.006
.85	4	.2623	.002
.85	6	.3662	.006
.85	8	.3632	.021
.85	12	.4043	.035
.85	15	.3856	.035
.85	20	.5665	.066
.85	23	.6569	.078
.90	- 2	.0998	-.001
.90	0	.0204	.004
.90	2	.1603	.006
.90	4	.2728	.001
.90	6	.3986	-.008
.90	8	.4063	.027
.90	12	.4134	.032
.90	15	.4141	.036
.90	20	.5954	.073
.95	- 2	.1014	-.001
.95	0	.0227	.004
.95	2	.1647	.007
.95	4	.2888	-.000
.95	6	.4282	-.011
.95	8	.5969	.012
.95	12	.4435	.044
.95	15	.4702	.044

(No data obtained at station 0.850b_v
for horizontal tail at 0.5b_v.)

TABLE III - Continued

SECTION CHARACTERISTICS, STATION 0.850b_v(b) $\alpha = 4^\circ$.

M	β , deg	Horizontal tail at 1.0b _v	
		c _n	c _m
.60	- 2	.0808	.001
.60	0	.0143	.003
.60	2	.1176	.005
.60	4	.2234	.004
.60	6	.3113	.017
.60	8	.4694	.066
.60	12	.4563	.065
.60	15	.4432	.059
.60	20	.4967	.063
.60	23	.5395	.073
.80	- 2	.0888	-.000
.80	0	.0184	.004
.80	2	.1281	.005
.80	4	.2321	.003
.80	6	.3354	.022
.80	8	.4659	.070
.80	12	.4346	.058
.80	15	.4202	.052
.80	20	.5443	.066
.80	23	.6123	.074
.85	- 2	.0933	-.000
.85	0	.0149	.003
.85	2	.1313	.005
.85	4	.2373	.002
.85	6	.3447	.023
.85	8	.4693	.067
.85	12	.4521	.057
.85	15	.4260	.052
.85	20	.5633	.068
.85	23	.6521	.079
.90	- 2	.0864	-.000
.90	0	.0168	.004
.90	2	.1348	.005
.90	4	.2471	.002
.90	6	.3552	.016
.90	8	.4563	.064
.90	12	.4444	.052
.90	15	.4367	.054
.90	20	.5827	.073
.95	- 2	.0959	-.001
.95	0	.0200	.004
.95	2	.1306	.004
.95	4	.2545	.002
.95	6	.3745	-.008
.95	8	.4731	.062
.95	12	.4664	.058
.95	15	.4884	.058

(No data obtained at station 0.850b_v
for horizontal tail at 0.5b_v.)

TABLE III - Concluded

SECTION CHARACTERISTICS, STATION 0.850b_v(c) $\alpha = 12^\circ$.

M	β , deg	Horizontal tail at 1.0b _v	
		c _n	c _m
.60	- 2	.0677	-.002
.60	0	-.0202	.001
.60	2	-.1117	.003
.60	4	-.2068	.003
.60	6	-.3304	.015
.60	8	-.4670	.053
.60	12	-.5585	.089
.60	15	-.5122	.080
(No data obtained at station 0.850b _v for horizontal tail at 0.5b _v .)			
.80	- 2	.0760	-.001
.80	0	-.0216	.002
.80	2	-.1209	.004
.80	4	-.2129	.004
.80	6	-.3586	.024
.80	8	-.4659	.068
.80	12	-.5403	.093
.80	15	-.5315	.089
.85	- 2	.0821	-.000
.85	0	-.0246	.003
.85	2	-.1186	.005
.85	4	-.2171	.005
.85	6	-.3522	.021
.85	8	-.4700	.074
.85	12	-.5118	.091
.85	15	-.5305	.091
.90	- 2	.0793	-.000
.90	0	-.0175	.003
.90	2	-.1165	.005
.90	4	-.2098	.005
.90	6	-.3516	.026
.90	8	-.4639	.077
.90	12	-.5137	.084
.95	- 2	.0779	-.001
.95	0	-.0200	.003
.95	2	-.1139	.005
.95	4	-.2151	.005
.95	6	-.3422	.027
.95	8	-.4574	.074

TABLE IV

SECTION CHARACTERISTICS, STATION 0.700b_v(a) $\alpha = 0^\circ$.

M	β , deg	Horizontal tail at 0.5b _v		Horizontal tail at 1.0b _v	
		c _n	c _m	c _n	c _m
.60	- 2	.1164	.003	.1001	.001
.60	0	.0000	-.000	-.0071	.002
.60	2	-.0804	-.005	-.1156	.002
.60	4	-.1824	-.011	-.2169	.000
.60	6	-.2736	-.013	-.3193	.006
.60	8	-.3840	-.010	-.3789	.026
.60	12	-.7199	.016	-.6446	.096
.60	15	-.3819	.080	-.6363	.087
.60	20	-.7559	.095	-.6172	.073
.60	23	-.7439	.098	-.7101	.082
.80	- 2	.1132	.005	.1132	.000
.80	0	.0162	.000	-.0016	.002
.80	2	-.0889	-.005	-.1205	.002
.80	4	-.1835	-.013	-.2337	-.002
.80	6	-.2951	-.014	-.3357	.005
.80	8	-.4164	-.011	-.4465	.039
.80	12	-.7600	.029	-.6369	.079
.80	15	-.7697	.092	-.5662	.069
.80	20	-.6630	.082	-.6553	.078
.80	23	-.6913	.092	-.7613	.099
.85	- 2	.1130	.004	.1153	-.001
.85	0	.0090	.001	-.0067	.001
.85	2	-.0882	-.005	-.1288	.001
.85	4	-.1929	-.014	-.2426	-.004
.85	6	-.3037	-.015	-.3549	-.002
.85	8	-.4469	-.011	-.4381	.037
.85	12	-.7611	.053	-.6148	.073
.85	15	-.7385	.089	-.5691	.065
.85	20	-.6715	.081	-.6777	.085
.85	23	-.7295	.093	-.7885	.108
.90	- 2	.0992	.007	.1204	-.000
.90	0	.0021	.003	-.0070	.001
.90	2	-.0836	-.007	-.1289	.001
.90	4	-.1949	-.014	-.2564	-.006
.90	6	-.3204	-.012	-.3747	-.017
.90	8	-.4402	.008	-.4614	.032
.90	12	-.7486	.045	-.5628	.068
.90	15	-.7195	.083	-.5832	.066
.90	20	-.6642	.082	-.7079	.093
.95	- 2	.1036	.003	.1143	-.000
.95	0	.0047	.003	-.0060	.000
.95	2	-.0908	-.006	-.1284	-.000
.95	4	-.2045	-.009	-.2607	-.009
.95	6	-.3201	-.008	-.4111	-.021
.95	8	-.4506	-.009	-.5288	-.014
.95	12	-.7479	.065	-.6645	.085
.95	15	-.7351	.087	-.6424	.078

TABLE IV - Continued

SECTION CHARACTERISTICS, STATION 0.700b_v(b) $\alpha = 4^\circ$.

M	β , deg	Horizontal tail at 0.5b _v		Horizontal tail at 1.0b _v	
		c _n	c _n	c _n	c _m
.60	- 2	.1043	.005	.0870	-.000
.60	0	.0264	.003	-.0119	.002
.60	2	-.0647	-.003	-.1120	.002
.60	4	-.1582	-.009	-.2062	-.000
.60	6	-.2541	-.011	-.3099	.011
.60	8	-.3608	-.012	-.4088	.042
.60	12	-.6401	-.011	-.7211	.109
.60	15	-.8343	.050	-.6722	.104
.60	20	-.7384	.097	-.6841	.099
.60	23	-.7156	.101	-.7402	.113
.80	- 2	.1091	.005	.0923	-.001
.80	0	.0105	.002	-.0144	.002
.80	2	-.0808	-.003	-.1148	.001
.80	4	-.1697	-.012	-.2135	-.001
.80	6	-.2763	-.013	-.3267	.014
.80	8	-.3878	-.015	-.4326	.047
.80	12	-.6116	-.011	-.6798	.108
.80	15	-.7538	.085	-.5931	.091
.80	20	-.6601	.085	-.6405	.086
.80	23	-.6787	.095	-.7665	.107
.85	- 2	.0964	.006	.0987	-.001
.85	0	-.0023	.003	-.0135	.002
.85	2	-.0896	-.003	-.1189	.001
.85	4	-.1837	-.012	-.2229	-.002
.85	6	-.2989	-.012	-.3344	.011
.85	8	-.4156	-.019	-.4466	.051
.85	12	-.6678	.005	-.6456	.101
.85	15	-.7077	.082	-.5917	.083
.85	20	-.6595	.083	-.6635	.090
.85	23	-.6836	.094	-.7862	.114
.90	- 2	.0956	.001	.0992	-.001
.90	0	-.0035	.002	-.0148	.002
.90	2	-.0963	-.001	-.1203	.001
.90	4	-.1877	-.008	-.2329	-.003
.90	6	-.3010	-.007	-.3378	.000
.90	8	-.4440	.001	-.4412	.049
.90	12	-.7018	.048	-.5932	.088
.90	15	-.6798	.078	-.5995	.079
.90	20	-.6501	.081	-.6720	.095
.95	- 2	.1069	-.004	.1008	-.001
.95	0	-.0040	.002	-.0154	.001
.95	2	-.0880	-.003	-.1236	.001
.95	4	-.1936	-.006	-.2404	-.007
.95	6	-.3152	-.002	-.3580	-.017
.95	8	-.4328	-.002	-.4535	.043
.95	12	-.6842	.046	-.6685	.108
.95	15	-.7064	.086	-.6485	.089

TABLE IV - Concluded
SECTION CHARACTERISTICS, STATION 0.700b_v

(c) $\alpha = 12^\circ$.

M	β , deg	Horizontal tail at 0.5b _v		Horizontal tail at 1.0b _v	
		c _n	c _m	c _n	c _m
.60	- 2	.0731	.006	.0704	-.001
.60	0	.0000	.002	-.0060	.001
.60	2	-.0815	-.004	-.0943	.002
.60	4	-.1618	-.011	-.1849	.002
.60	6	-.2589	-.012	-.2959	.013
.60	8	-.3404	-.020	-.4593	.020
.60	12	-.5490	-.030	-.6562	.086
.60	15	-.7252	.065	-.7433	.118
.80	- 2	.0840	.006	.0780	-.001
.80	0	-.0145	.003	-.0137	.001
.80	2	-.0865	-.007	-.1045	.002
.80	4	-.1729	-.010	-.2075	.002
.80	6	-.2691	-.012	-.3112	.018
.80	8	-.3676	-.025	-.4608	.037
.80	12	-.6044	-.004	-.6707	.101
.80	15	-.6391	.068	-.6964	.120
.85	- 2	.0851	.003	.0727	-.000
.85	0	.0060	-.001	-.0180	.001
.85	2	-.0640	-.010	-.1064	.002
.85	4	-.1807	-.003	-.2075	.003
.85	6	-.2793	-.006	-.3199	.018
.85	8	-.3749	-.015	-.4802	.039
.85	12	-.6173	.022	-.6839	.102
.85	15	-.6068	.068	-.6787	.120
.90	- 2	.0927	-.003	.0740	-.000
.90	0	.0142	-.005	-.0120	.001
.90	2	-.0736	-.004	-.1035	.002
.90	4	-.1932	.007	-.2050	.001
.90	6	-.2810	.002	-.3226	.017
.90	8	-.3687	-.009	-.4783	.038
.90	12	-.5952	.031	-.6452	.104
.95	- 2	.0826	-.002	.0695	-.000
.95	0	-.0034	-.001	-.0200	.001
.95	2	-.0698	-.006	-.1036	.002
.95	4	-.1611	-.002	-.2031	.000
.95	6	-.2619	.000	-.3193	.013
.95	8	-.3525	-.002	-.4777	.029

TABLE V
SECTION CHARACTERISTICS, STATION 0.560b_v

(a) $\alpha = 0^\circ$.

M	β , deg	Horizontal tail at 0.5b _v		Horizontal tail at 1.0b _v	
		c _n	c _m	c _n	c _m
.60	- 2	.0976	-.004	.0920	-.002
.60	0	.0095	-.004	-.0108	-.001
.60	2	-.0822	-.005	-.1255	-.001
.60	4	-.1798	-.003	-.2330	-.001
.60	6	-.2846	-.007	-.3346	.005
.60	8	-.4060	-.008	-.4864	.024
.60	12	-.6394	-.009	-.8676	.112
.60	15	-.7954	.003	-.9298	.138
.60	20	-.8109	.113	-.3186	.108
.60	23	-.7966	.118	-.8605	.128
.80	- 2	.1035	-.005	.0991	-.000
.80	0	.0040	-.004	-.0137	.000
.80	2	-.0907	-.004	-.1329	.001
.80	4	-.1934	-.002	-.2449	-.002
.80	6	-.3169	-.002	-.3512	.006
.80	8	-.4493	-.004	-.5566	.039
.80	12	-.6667	.001	-.8410	.127
.80	15	-.8320	.034	-.8072	.110
.80	20	-.7341	.098	-.7701	.104
.80	23	-.7566	.107	-.8885	.132
.85	- 2	.1010	-.006	.0797	.000
.85	0	.0000	-.003	-.0143	.001
.85	2	-.0987	-.002	-.1368	.001
.85	4	-.2086	-.000	-.2496	-.003
.85	6	-.3290	-.001	-.3744	-.001
.85	8	-.4681	-.001	-.6293	.041
.85	12	-.6701	.002	-.8150	.127
.85	15	-.8346	.042	-.7669	.098
.85	20	-.7232	.097	-.7857	.098
.85	23	-.7508	.106	-.8924	.135
.90	- 2	.0935	-.010	.1019	.000
.90	0	-.0014	-.005	-.0149	.001
.90	2	-.1076	.001	-.1430	.001
.90	4	-.2292	.007	-.2647	-.005
.90	6	-.3466	.007	-.3970	-.017
.90	8	-.4844	.007	-.5329	.026
.90	12	-.6749	.011	-.7976	.118
.90	15	-.8260	.058	-.7565	.093
.90	20	-.7241	.095	-.7841	.117
.95	- 2	.0880	-.008	.1000	.001
.95	0	-.0080	-.004	-.0369	.001
.95	2	-.1080	.001	-.1578	.001
.95	4	-.2148	.005	-.2874	-.004
.95	6	-.3442	.004	-.4391	-.010
.95	8	-.4655	.002	-.5687	-.010
.95	12	-.6736	.016	-.9252	.123
.95	15	-.8144	.062	-.8500	.118

TABLE V - Continued

SECTION CHARACTERISTICS, STATION 0.560b_v(b) $\alpha = 4^\circ$.

M	β , deg	Horizontal tail at 0.5b _v		Horizontal tail at 1.0b _v	
		c _n	c _m	c _n	c _m
.60	- 2	.0822	-.001	.0898	-.000
.60	0	-.0060	-.001	-.0060	.000
.60	2	-.0905	-.002	-.1102	.001
.60	4	-.1763	-.000	-.2120	.000
.60	6	-.2835	-.001	-.3522	.006
.60	8	-.3978	-.001	-.4816	.024
.60	12	-.6182	-.006	-.7966	.077
.60	15	-.7540	-.002	-.9379	.133
.60	20	-.8040	.117	-.8996	.141
.60	23	-.7647	.120	-.9978	.179
.80	- 2	.0907	-.003	.0888	-.000
.80	0	-.0064	-.000	-.0097	.001
.80	2	-.0939	-.000	-.1171	.002
.80	4	-.1909	.000	-.2261	-.000
.80	6	-.3089	.004	-.3480	.007
.80	8	-.4332	.006	-.5240	.028
.80	12	-.6226	-.000	-.8195	.113
.80	15	-.7590	.031	-.8308	.127
.80	20	-.6707	.100	-.8026	.119
.80	23	-.6916	.105	-.8922	.144
.85	- 2	.0988	-.007	.0895	-.000
.85	0	.0037	-.002	-.0128	.002
.85	2	-.0936	.003	-.1196	.002
.85	4	-.1910	.004	-.2295	-.001
.85	6	-.3040	.007	-.3551	-.007
.85	8	-.4313	.007	-.5312	-.028
.85	12	-.6328	.007	-.7990	-.127
.85	15	-.7608	.042	-.8103	-.125
.85	20	-.6567	.096	-.8005	-.129
.85	23	-.8394	.081	-.8893	-.155
.90	- 2	.1022	-.011	.0941	-.000
.90	0	.0028	-.003	-.0120	.002
.90	2	-.0994	.005	-.1217	.001
.90	4	-.2002	.007	-.2300	-.002
.90	6	-.3152	.011	-.3531	.002
.90	8	-.4379	.015	-.5428	.024
.90	12	-.5979	.005	-.7459	.114
.90	15	-.7326	.055	-.7792	.113
.90	20	-.6480	.093	-.8308	.123
.95	- 2	.0877	-.007	.0759	-.000
.95	0	-.0013	-.002	-.0128	.002
.95	2	-.0950	.003	-.1276	.002
.95	4	-.1941	.005	-.2578	-.003
.95	6	-.3038	.008	-.3653	-.007
.95	8	-.4276	.007	-.5063	.028
.95	12	-.5902	.013	-.8339	.110
.95	15	-.7120	.063	-.8124	.125

TABLE V - Concluded
SECTION CHARACTERISTICS, STATION 0.560b_v

(c) $\alpha = 12^\circ$.

M	β , deg	Horizontal tail at 0.5b _v		Horizontal tail at 1.0b _v	
		c _n	c _m	c _n	c _m
.60	- 2	.0777	.001	.0740	.000
.60	0	.0024	.001	-.0036	.001
.60	2	-.0729	.001	-.0907	.002
.60	4	-.1565	.003	-.1909	-.000
.60	6	-.2604	.006	-.3186	.001
.60	8	-.3572	.006	-.4351	.003
.60	12	-.5101	.003	-.6906	.030
.60	15	-.6356	.038	-.8559	.096
.80	- 2	.0765	-.006	.0753	-.000
.80	0	-.0040	.002	-.0176	.001
.80	2	-.0910	.010	-.1081	.001
.80	4	-.1812	.014	-.2090	.001
.80	6	-.2892	.018	-.3275	.003
.80	8	-.3931	.018	-.4500	.006
.80	12	-.5204	.009	-.7166	.060
.80	15	-.6090	.054	-.8367	.115
.85	- 2	.0878	-.013	.0702	.000
.85	0	.0090	-.003	-.0157	.001
.85	2	-.0826	.008	-.1097	.002
.85	4	-.1831	.017	-.2023	.001
.85	6	-.2822	.023	-.3285	.002
.85	8	-.3708	.017	-.4539	.006
.85	12	-.5269	.014	-.7025	.069
.85	15	-.5712	.061	-.8026	.118
.90	- 2	.0805	-.012	.0674	.001
.90	0	.0155	-.007	-.0140	.002
.90	2	-.0692	.002	-.1025	.002
.90	4	-.1539	.006	-.2064	.001
.90	6	-.2450	.006	-.3229	.000
.90	8	-.3375	.004	-.4493	.005
.90	12	-.4660	-.002	-.6859	.079
.95	- 2	.0730	-.009	.0706	.001
.95	0	.0074	-.004	-.0153	.002
.95	2	-.0697	.002	-.1066	.002
.95	4	-.1535	.006	-.2059	-.000
.95	6	-.2386	.003	-.3152	.002
.95	8	-.3317	-.002	-.4571	.005

TABLE VI
SECTION CHARACTERISTICS, STATION 0.450b_v

(a) $\alpha = 0^\circ$.

M	β , deg	Horizontal tail at 0.5b _v	
		c _n	c _m
.60	- 2	.1280	-.000
.60	0	.0095	-.002
.60	2	-.1102	-.006
.60	4	-.2298	-.012
.60	6	-.3412	-.013
.60	8	-.4502	-.001
.60	12	-.5450	.020
.60	15	-.5900	.014
.60	20	-.7902	.055
.60	23	-.8696	.076
.80	- 2	.1237	-.001
.80	0	.0064	-.003
.80	2	-.1245	-.006
.80	4	-.2435	-.014
.80	6	-.3680	-.014
.80	8	-.4766	-.006
.80	12	-.5612	.009
.80	15	-.5868	.012
.80	20	-.8055	.052
.80	23	-.8965	.091
.85	- 2	.1376	-.001
.85	0	.0074	-.003
.85	2	-.1235	-.007
.85	4	-.2499	-.015
.85	6	-.3779	-.016
.85	8	-.4984	-.009
.85	12	-.5542	.005
.85	15	-.6062	.010
.85	20	-.8324	.052
.85	23	-.9410	.093
.90	- 2	.1421	-.003
.90	0	.0084	-.004
.90	2	-.1274	-.007
.90	4	-.2534	-.015
.90	6	-.3997	-.022
.90	8	-.5215	-.010
.90	12	-.5852	.015
.90	15	-.6335	.007
.90	20	-.8805	.064
.95	- 2	.1474	-.005
.95	0	.0113	-.005
.95	2	-.1375	-.006
.95	4	-.2636	-.013
.95	6	-.4117	-.020
.95	8	-.5519	-.029
.95	12	-.6993	.028
.95	15	-.7126	.020

(No data obtained at station 0.450b_v
for horizontal tail at 1.0b_v.)

TABLE VI - Continued

SECTION CHARACTERISTICS, STATION 0.450b_v(b) $\alpha = 4^\circ$.

M	β , deg	Horizontal tail at 0.5b _v	
		C _n	C _m
.60	- 2	.1174	-.002
.60	0	.0107	-.003
.60	2	-.1032	-.005
.60	4	-.2158	-.009
.60	6	-.3107	-.010
.60	8	-.4163	.002
.60	12	-.5301	.019
.60	15	-.5776	.022
.60	20	-.7649	.051
.60	23	-.8159	.073

.80	- 2	.1159	-.002
.80	0	.0056	-.003
.80	2	-.1119	-.006
.80	4	-.2230	-.011
.80	6	-.3349	-.011
.80	8	-.4540	-.006
.80	12	-.5508	.016
.80	15	-.5979	.027
.80	20	-.8202	.073
.80	23	-.8865	.101

(No data obtained at station 0.450b_v
for horizontal tail at 1.0b_v.)

.85	- 2	.1304	-.002
.85	0	.0067	-.003
.85	2	-.1125	-.005
.85	4	-.2340	-.011
.85	6	-.3360	-.012
.85	8	-.4739	-.005
.85	12	-.5663	.014
.85	15	-.6169	.027
.85	20	-.8405	.075
.85	23	-.9344	.106

.90	- 2	.1283	-.003
.90	0	.0056	-.003
.90	2	-.1136	-.006
.90	4	-.2405	-.011
.90	6	-.3478	-.014
.90	8	-.5048	-.015
.90	12	-.5938	.023
.90	15	-.6198	.023
.90	20	-.8806	.081

.95	- 2	.1304	-.003
.95	0	.0060	-.004
.95	2	-.1211	-.006
.95	4	-.2488	-.012
.95	6	-.3792	-.018
.95	8	-.5168	-.015
.95	12	-.6213	.028
.95	15	-.7018	.030

TABLE VI - Concluded

SECTION CHARACTERISTICS, STATION 0.450b_v(c) $\alpha = 12^\circ$.

M	β , deg	Horizontal tail at 0.5b _v	
		c _n	c _m
.60	- 2	.1020	-.003
.60	0	-.0012	-.003
.60	2	-.1091	-.003
.60	4	-.2076	-.004
.60	6	-.3025	-.004
.60	8	-.3761	-.000
.60	12	-.4817	.003
.60	15	-.5410	.011
.80	- 2	.1119	-.005
.80	0	-.0016	-.004
.80	2	-.1183	-.003
.80	4	-.2254	-.005
.80	6	-.3150	-.004
.80	8	-.4205	.003
.80	12	-.5388	.011
.80	15	-.6331	.030
.85	- 2	.1111	-.005
.85	0	-.0007	-.004
.85	2	-.1401	-.004
.85	4	-.2348	-.005
.85	6	-.3362	-.005
.85	8	-.4465	.004
.85	12	-.5612	.016
.85	15	-.6514	.037
.90	- 2	.1121	-.005
.90	0	-.0042	-.004
.90	2	-.1241	-.004
.90	4	-.2348	-.006
.90	6	-.3574	-.007
.90	8	-.4458	.003
.90	12	-.5845	.023
.95	- 2	.1090	-.005
.95	0	-.0020	-.004
.95	2	-.1203	-.004
.95	4	-.2413	-.006
.95	6	-.3756	-.011
.95	8	-.4766	.004

(No data obtained at station 0.450b_v
for horizontal tail at 1.0b_v.)

TABLE VII
SECTION CHARACTERISTICS, STATION 0.500b_v

(a) $\alpha = 0^\circ$.

M	β , deg	Horizontal tail at 0.5b _v		Horizontal tail at 1.0b _v	
		c _n	c _m	c _n	c _m
.60	- 2	.1261	-.006	.1056	-.001
.60	0	.0131	-.003	-.0083	.001
.60	2	-.1023	-.002	-.1175	.003
.60	4	-.2153	-.000	-.2290	.004
.60	6	-.3354	.001	-.3513	.005
.60	8	-.4710	.002	-.4996	-.002
.60	12	-.7684	.012	-.7975	-.016
.60	15	-.9599	.089	-1.0574	.011
.60	20	-1.0503	.164	-1.1761	.190
.60	23	-1.1051	.184	-1.1820	.199
.80	- 2	.1314	-.007	.1087	-.003
.80	0	.0168	-.004	-.0120	.000
.80	2	-.1050	-.001	-.1295	.003
.80	4	-.2308	.000	-.2453	.005
.80	6	-.3623	.003	-.3756	.007
.80	8	-.5049	.009	-.5274	-.004
.80	12	-.8263	.038	-.8455	.012
.80	15	-.9498	.111	-1.1076	.095
.80	20	-1.0820	.175	-.9941	.159
.80	23	-1.1502	.193	-1.0716	.179
.85	- 2	.1330	-.008	.0842	-.002
.85	0	.0194	-.005	-.0350	.001
.85	2	-.1106	-.001	-.1513	.004
.85	4	-.2362	.002	-.2720	.006
.85	6	-.3699	.006	-.4068	.008
.85	8	-.5142	.011	-.5626	.002
.85	12	-.8497	.051	-.8286	.014
.85	15	-.9648	.119	-1.1117	.114
.85	20	-1.1053	.182	-.9597	.157
.85	23	-1.1688	.200	-1.0513	.178
.90	- 2	.1350	-.010	.1226	-.003
.90	0	.0169	-.006	-.0021	.001
.90	2	-.1153	-.000	-.1226	.005
.90	4	-.2482	.004	-.2508	.008
.90	6	-.3930	.011	-.3980	.012
.90	8	-.5279	.007	-.5486	.014
.90	12	-.8401	.055	-.8106	.020
.90	15	-1.0165	.133	-1.1007	.124
.90	20	-1.1606	.196	-.9914	.169
.95	- 2	.1374	-.012	.1236	-.007
.95	0	.0127	-.005	-.0053	-.000
.95	2	-.1147	.002	-.1310	.007
.95	4	-.2441	.008	-.2646	.013
.95	6	-.3982	.016	-.4088	.019
.95	8	-.5656	.027	-.5757	.031
.95	12	-.8297	.044	-.8475	.050
.95	15	-1.0831	.136	-1.0596	.098

TABLE VII - Continued
SECTION CHARACTERISTICS, STATION 0.300b_v

(b) $\alpha = 4^\circ$.

M	β , deg	Horizontal tail at 0.5b _v		Horizontal tail at 1.0b _v	
		c _n	c _m	c _n	c _m
.60	- 2	.1093	-.004	.0973	-.000
.60	0	.0083	-.002	-.0059	.002
.60	2	-.0974	-.000	-.1116	.004
.60	4	-.2031	.001	-.2160	.006
.60	6	-.3124	-.000	-.3252	.005
.60	8	-.4348	-.003	-.4605	-.003
.60	12	-.7258	.014	-.7548	-.012
.60	15	-.9052	.082	-.9791	.008
.60	20	-1.0109	.164	-1.3030	.153
.60	23	-1.0430	.176	-1.2793	.215
.80	- 2	.1193	-.006	.0984	-.001
.80	0	.0088	-.003	-.0088	.001
.80	2	-.1009	-.000	-.1151	.004
.80	4	-.2114	.002	-.2295	.006
.80	6	-.3347	.002	-.3502	.004
.80	8	-.4588	.002	-.4878	-.004
.80	12	-.7575	.035	-.7485	.004
.80	15	-.9072	.107	-1.0299	.062
.80	20	-.9977	.171	-1.0467	.179
.80	23	-1.0673	.186	-1.0851	.190
.85	- 2	.1097	-.006	.1007	-.002
.85	0	.0067	-.003	-.0089	.001
.85	2	-.1060	.000	-.1185	.004
.85	4	-.2284	.003	-.2319	.006
.85	6	-.3433	.004	-.3586	.004
.85	8	-.4747	.007	-.4884	-.001
.85	12	-.7702	.044	-.7702	.010
.85	15	-.9344	.112	-1.0520	.085
.85	20	-1.0493	.178	-1.0252	.176
.85	23	-1.0628	.184	-1.0707	.189
.90	- 2	.1060	-.007	.0961	-.003
.90	0	.0077	-.003	-.0119	.001
.90	2	-.1116	.001	-.1206	.005
.90	4	-.2317	.004	-.2328	.007
.90	6	-.3580	.007	-.3556	.007
.90	8	-.4823	.014	-.4979	.004
.90	12	-.7989	.054	-.7350	.015
.90	15	-.9639	.121	-1.0324	.089
.90	20	-1.0769	.186	-1.0401	.181
.95	- 2	.1133	-.008	.1032	-.004
.95	0	.0053	-.003	-.0107	.001
.95	2	-.1140	.002	-.1265	.006
.95	4	-.2427	.006	-.2444	.010
.95	6	-.3614	.009	-.3742	.014
.95	8	-.4901	.017	-.5034	.014
.95	12	-.7921	.051	-.7677	.033
.95	15	-.9841	.123	-.9388	.062

TABLE VII - Concluded
SECTION CHARACTERISTICS, STATION 0.300b_v

(c) $\alpha = 12^\circ$.

M	β , deg	Horizontal tail at 0.5b _v		Horizontal tail at 1.0b _v	
		c _n	c _m	c _n	c _m
.60	- 2	.1105	-.005	.0858	.000
.60	0	.0048	-.002	.0155	.003
.60	2	-.0998	.002	-.0822	.006
.60	4	-.2091	.003	-.1788	.007
.60	6	-.3124	.005	-.2920	.006
.60	8	-.4443	.003	-.4219	.002
.60	12	-.7080	.022	-.7259	.004
.60	15	-.8838	.064	-.8963	.020
.80	- 2	.1040	-.007	.0857	-.001
.80	0	-.0064	-.002	-.0184	.003
.80	2	-.1168	.003	-.0953	.006
.80	4	-.2281	.005	-.2026	.007
.80	6	-.3473	.007	-.3195	.005
.80	8	-.4641	.009	-.4412	.004
.80	12	-.7674	.042	-.7046	.015
.80	15	-.9186	.094	-.9112	.048
.85	- 2	.1037	-.006	.1075	-.001
.85	0	-.0090	-.001	.0045	.002
.85	2	-.1209	.004	-.1000	.006
.85	4	-.2387	.006	-.2046	.008
.85	6	-.3596	.009	-.3315	.005
.85	8	-.4894	.011	-.4502	.007
.85	12	-.7826	.053	-.7085	.020
.85	15	-.9363	.097	-.8496	.055
.90	- 2	.1031	-.006	.1053	-.001
.90	0	-.0112	-.001	.0035	.002
.90	2	-.1228	.004	-.0990	.006
.90	4	-.2448	.007	-.2190	.008
.90	6	-.3641	.010	-.3257	.007
.90	8	-.4967	.016	-.4584	.010
.90	12	-.7829	.062	-.6866	.030
.95	- 2	.1012	-.007	.0866	-.002
.95	0	-.0093	-.001	-.0173	.002
.95	2	-.1252	.005	-.1173	.007
.95	4	-.2490	.008	-.2285	.010
.95	6	-.3795	.013	-.3358	.011
.95	8	-.5060	.019	-.4664	.019

TABLE VIII
SECTION CHARACTERISTICS, STATION 0.200b_v

(a) $\alpha = 0^\circ$.

M	β , deg	Horizontal tail at 0.5b _v		Horizontal tail at 1.0b _v	
		c _n	c _m	c _n	c _m
.60	- 2	.1091	-.010	.0968	-.005
.60	0	.0059	-.005	-.0071	.002
.60	2	-.1020	.001	-.1133	.007
.60	4	-.2087	.008	-.2207	.014
.60	6	-.3297	.015	-.3387	.020
.60	8	-.4447	.021	-.4473	.025
.60	12	-.7199	.017	-.7269	.012
.60	15	-.9179	.028	-.9464	.016
.60	20	-1.0685	.159	-1.1518	.164
.60	23	-1.1444	.186	-1.1730	.203
.80	- 2	.1142	-.012	.0970	-.007
.80	0	.0064	-.005	-.0095	.000
.80	2	-.1046	.003	-.1208	.008
.80	4	-.2237	.012	-.2401	.017
.80	6	-.3507	.022	-.3633	.026
.80	8	-.4801	.027	-.4976	.031
.80	12	-.7293	.037	-.7575	.038
.80	15	-.9442	.058	-.9682	.066
.80	20	-1.1016	.177	-1.0429	.177
.80	23	-1.1647	.199	-1.1025	.203
.85	- 2	.1169	-.014	.1023	-.008
.85	0	.0089	-.006	-.0126	.001
.85	2	-.1102	.004	-.1230	.010
.85	4	-.2339	.015	-.2394	.020
.85	6	-.3605	.025	-.3713	.030
.85	8	-.4916	.033	-.5173	.038
.85	12	-.7396	.046	-.7582	.045
.85	15	-.9527	.069	-.9680	.082
.85	20	-1.1270	.184	-1.0354	.181
.85	23	-1.1910	.208	-1.1169	.208
.90	- 2	.1170	-.016	.1039	-.009
.90	0	.0063	-.006	-.0070	.001
.90	2	-.1100	.004	-.1262	.011
.90	4	-.2368	.017	-.2517	.024
.90	6	-.3706	.029	-.3862	.038
.90	8	-.5101	.042	-.5264	.048
.90	12	-.7315	.052	-.7669	.062
.90	15	-.9571	.087	-.9593	.095
.90	20	-1.1603	.190	-1.0499	.186
.95	- 2	.1137	-.016	.1025	-.013
.95	0	.0047	-.006	-.0099	.000
.95	2	-.1097	.004	-.1303	.016
.95	4	-.2347	.017	-.2600	.031
.95	6	-.3769	.033	-.3936	.047
.95	8	-.5271	.054	-.5345	.062
.95	12	-.7718	.074	-.7838	.086
.95	15	-.9433	.097	-.9188	.092

TABLE VIII - Continued

SECTION CHARACTERISTICS, STATION 0.200b_v(b) $\alpha = 4^\circ$.

M	β , deg	Horizontal tail at 0.5b _v		Horizontal tail at 1.0b _v	
		c _n	c _m	c _n	c _m
.60	- 2	.1079	-.009	.0920	-.003
.60	0	.0036	-.005	-.0059	.003
.60	2	-.1115	.001	-.1085	.009
.60	4	-.2052	.007	-.2040	.013
.60	6	-.3143	.011	-.3089	.018
.60	8	-.4186	.015	-.4221	.024
.60	12	-.7021	.024	-.7250	.023
.60	15	-.9262	.037	-.9019	.028
.60	20	-1.0863	.163	-1.2084	.089
.60	23	-1.1528	.181	-1.2567	.194
.80	- 2	.1014	-.011	.0937	-.005
.80	0	-.0040	-.004	-.0071	.002
.80	2	-.1126	.004	-.1096	.009
.80	4	-.2275	.011	-.2185	.016
.80	6	-.3473	.017	-.3336	.023
.80	8	-.4606	.021	-.4568	.027
.80	12	-.7352	.039	-.7340	.043
.80	15	-.9436	.065	-.9239	.062
.80	20	-1.1041	.172	-1.0843	.179
.80	23	-1.1799	.194	-1.1320	.208
.85	- 2	.1020	-.011	.0911	-.005
.85	0	-.0104	-.003	-.0096	.002
.85	2	-.1243	.006	-.1118	.010
.85	4	-.2322	.013	-.2237	.018
.85	6	-.3543	.021	-.3392	.025
.85	8	-.4876	.026	-.4674	.030
.85	12	-.7503	.051	-.7288	.047
.85	15	-.9707	.074	-.9243	.079
.85	20	-1.0793	.169	-1.0710	.180
.85	23	-1.2044	.201	-1.1117	.205
.90	- 2	.1008	-.012	.0945	-.007
.90	0	-.0063	-.003	-.0097	.002
.90	2	-.1162	.006	-.1195	.012
.90	4	-.2346	.014	-.2300	.020
.90	6	-.3809	.024	-.3502	.031
.90	8	-.4950	.032	-.4808	.037
.90	12	-.7562	.061	-.7413	.062
.90	15	-.9634	.086	-.9060	.089
.90	20	-1.1763	.191	-1.0727	.183
.95	- 2	.1043	-.013	.0985	-.010
.95	0	-.0053	-.004	-.0112	.002
.95	2	-.1202	.007	-.1243	.014
.95	4	-.2418	.017	-.2360	.026
.95	6	-.3647	.029	-.3609	.039
.95	8	-.4956	.041	-.4865	.047
.95	12	-.7546	.065	-.7436	.080
.95	15	-.9566	.101	-.9016	.092

TABLE VIII - Concluded

SECTION CHARACTERISTICS, STATION 0.200b_v(c) $\alpha = 12^\circ$.

M	β , deg	Horizontal tail at 0.5b _v		Horizontal tail at 1.0b _v	
		c _n	c _m	c _n	c _m
.60	- 2	.0856	-.012	.0649	-.005
.60	0	.0012	-.004	-.0130	.003
.60	2	-.0809	.004	-.0943	.011
.60	4	-.1831	.017	-.1911	.023
.60	6	-.3211	.029	-.3066	.032
.60	8	-.4352	.029	-.4104	.033
.60	12	-.6564	.029	-.6203	.026
.60	15	-.7979	.035	-.8279	.022
.80	- 2	.0824	-.015	.0683	-.007
.80	0	-.0072	-.004	-.0159	.003
.80	2	-.0952	.008	-.1017	.014
.80	4	-.1911	.023	-.1907	.027
.80	6	-.3095	.035	-.3099	.039
.80	8	-.4350	.041	-.4252	.041
.80	12	-.6621	.044	-.6517	.039
.80	15	-.8324	.062	-.8058	.053
.85	- 2	.0850	-.016	.0704	-.008
.85	0	-.0097	-.004	-.0133	.003
.85	2	-.0999	.009	-.0986	.014
.85	4	-.1953	.024	-.1897	.028
.85	6	-.3123	.038	-.3061	.041
.85	8	-.4398	.047	-.4225	.047
.85	12	-.6812	.054	-.6411	.049
.85	15	-.8326	.070	-.8064	.061
.90	- 2	.0772	-.016	.0676	-.008
.90	0	-.0112	-.003	-.0132	.002
.90	2	-.1039	.011	-.1004	.015
.90	4	-.1980	.027	-.1938	.031
.90	6	-.3145	.043	-.3081	.046
.90	8	-.4374	.054	-.4218	.054
.90	12	-.6782	.066	-.6588	.067
.95	- 2	.0818	-.016	.0714	-.011
.95	0	-.0100	-.003	-.0139	.002
.95	2	-.1031	.012	-.1065	.016
.95	4	-.1989	.030	-.1971	.035
.95	6	-.3120	.047	-.3109	.052
.95	8	-.4337	.060	-.4333	.067

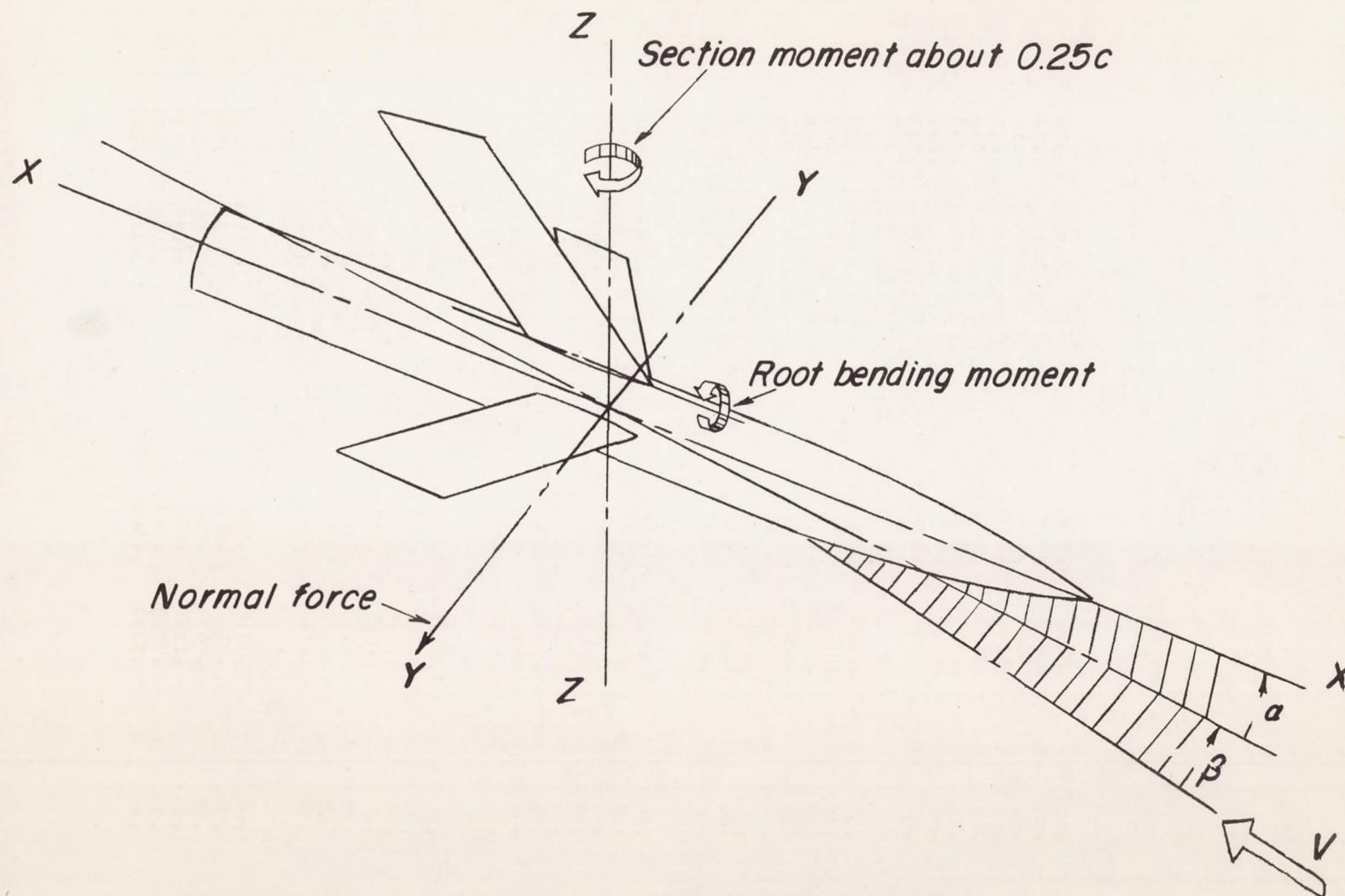


Figure 1.- System of axes used. Positive forces, moments, angles, and velocities are indicated by arrows.

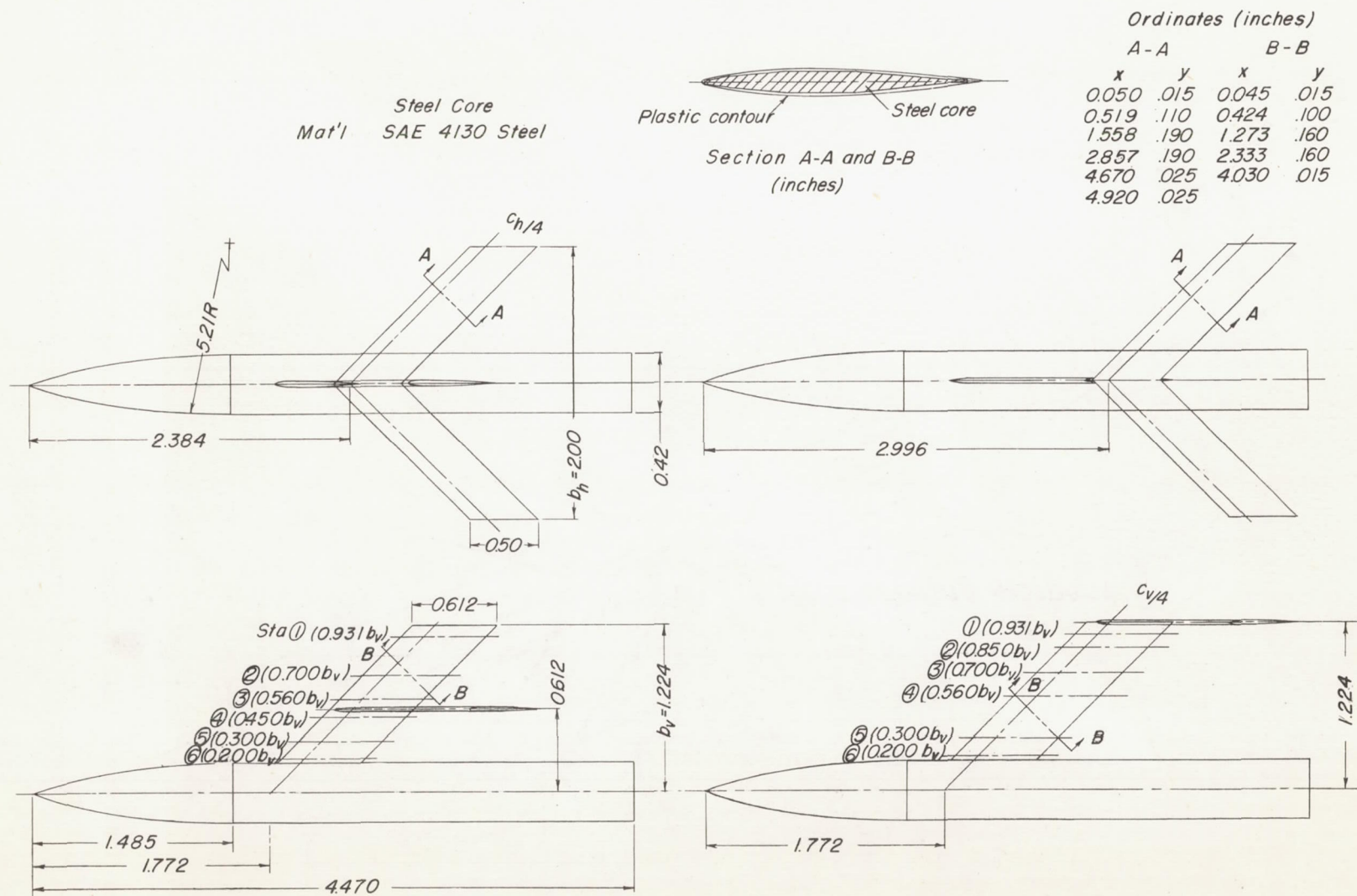
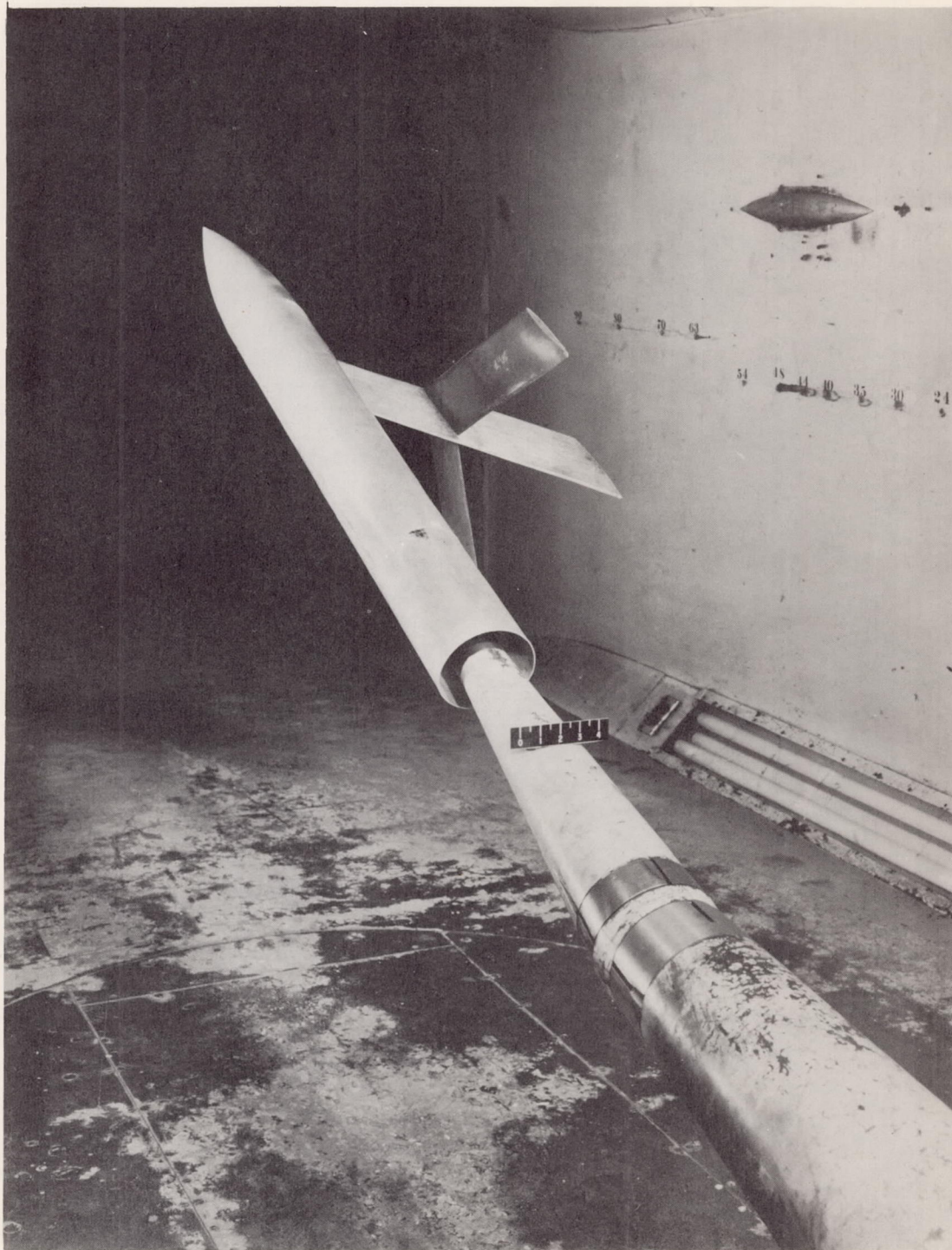


Figure 2.-Details of tail models tested. (All dimensions in feet unless otherwise noted.)



(a) Horizontal tail located at 50-percent vertical-tail span. L-83798

Figure 3.- Photograph of the model mounted in the Langley high-speed 7- by 10-foot tunnel.



(b) Horizontal tail located at 100-percent vertical-tail span. L-83797

Figure 3.- Concluded.

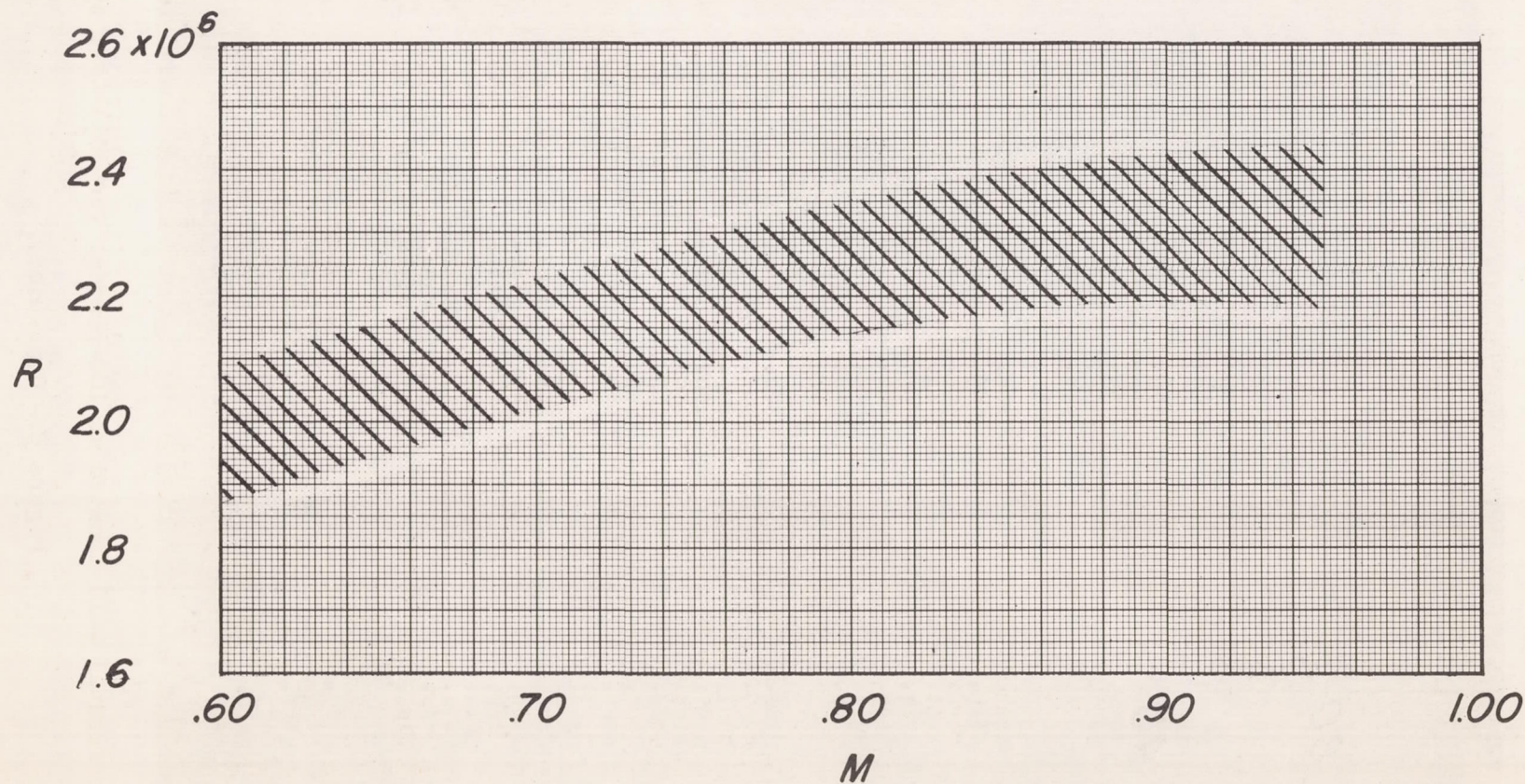
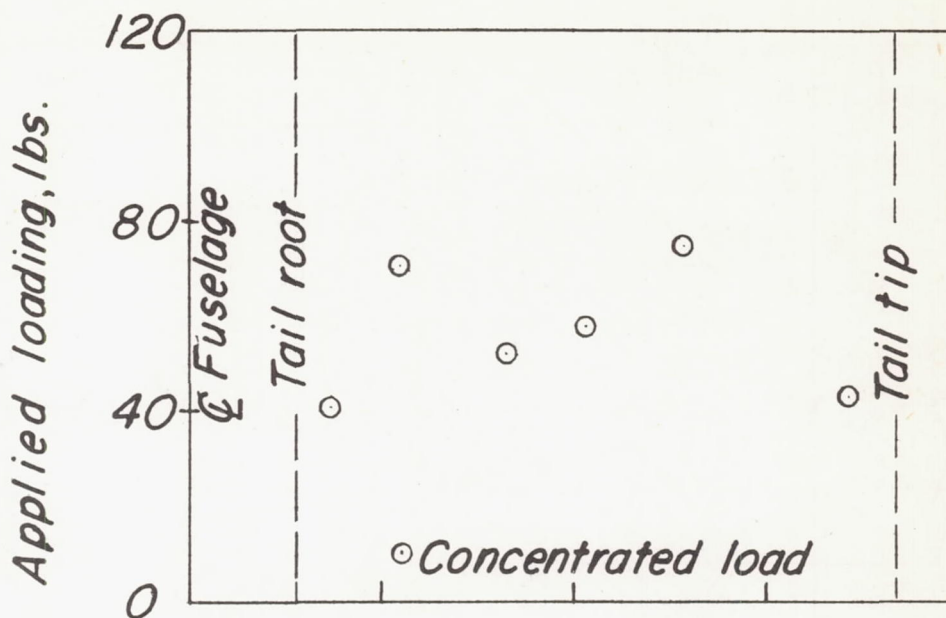
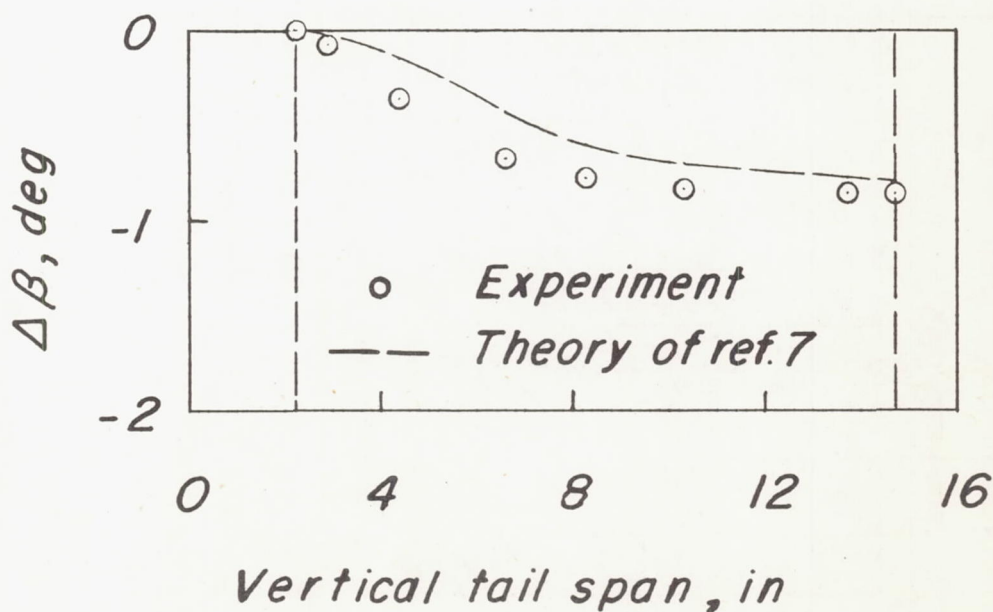


Figure 4.- Variation of test Reynolds number with Mach number. (Reynolds number is based on the mean aerodynamic chord of the vertical tail.)

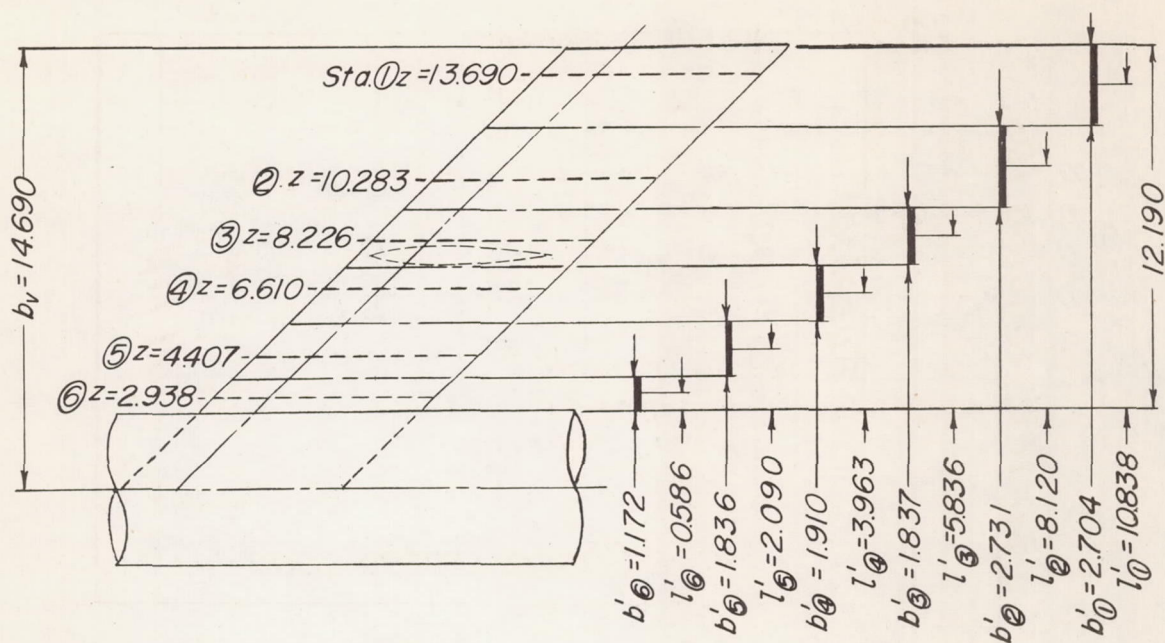


(a) Simulated loading on vertical tail in presence of horizontal tail at $0.5b_v$. $\alpha = 0^\circ$; $\beta = 15^\circ$; $M = 0.95$; $q = 746$ lb/sq ft.

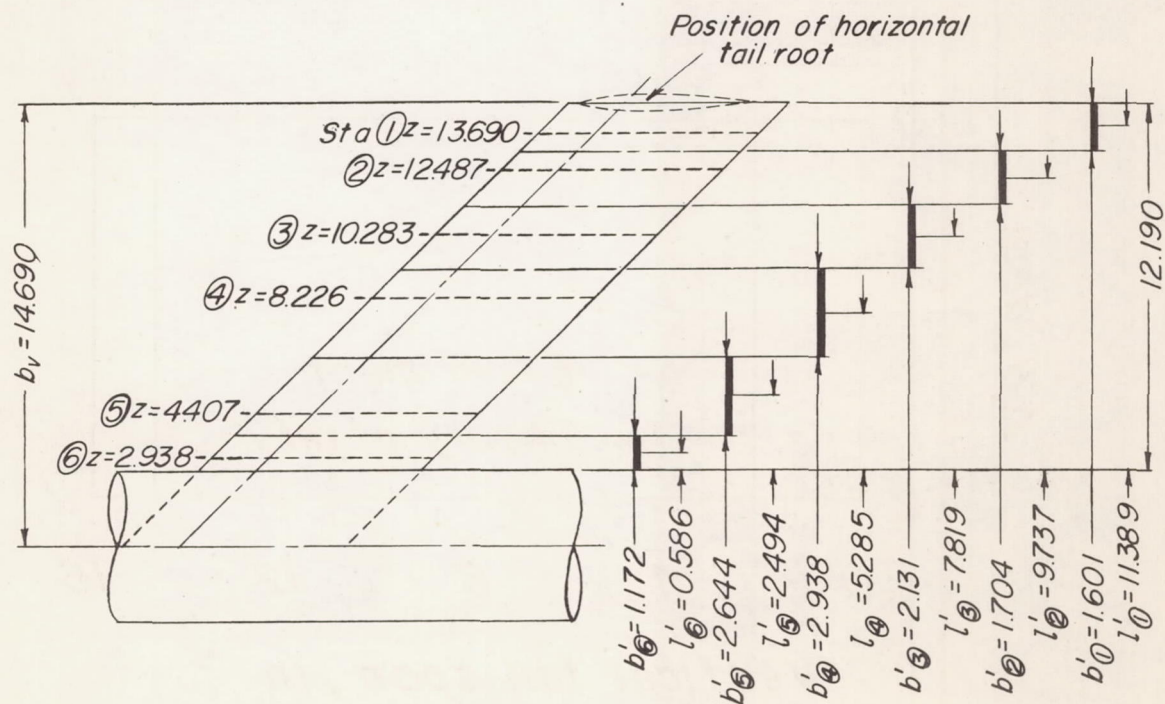


(b) Spanwise change in angle of sideslip $\Delta\beta$ of vertical tail due to simulated experimental loading condition.

Figure 5.- Spanwise change in angle of sideslip $\Delta\beta$ of vertical tail in presence of horizontal tail at $0.5b_v$ for simulated experimental loading condition.

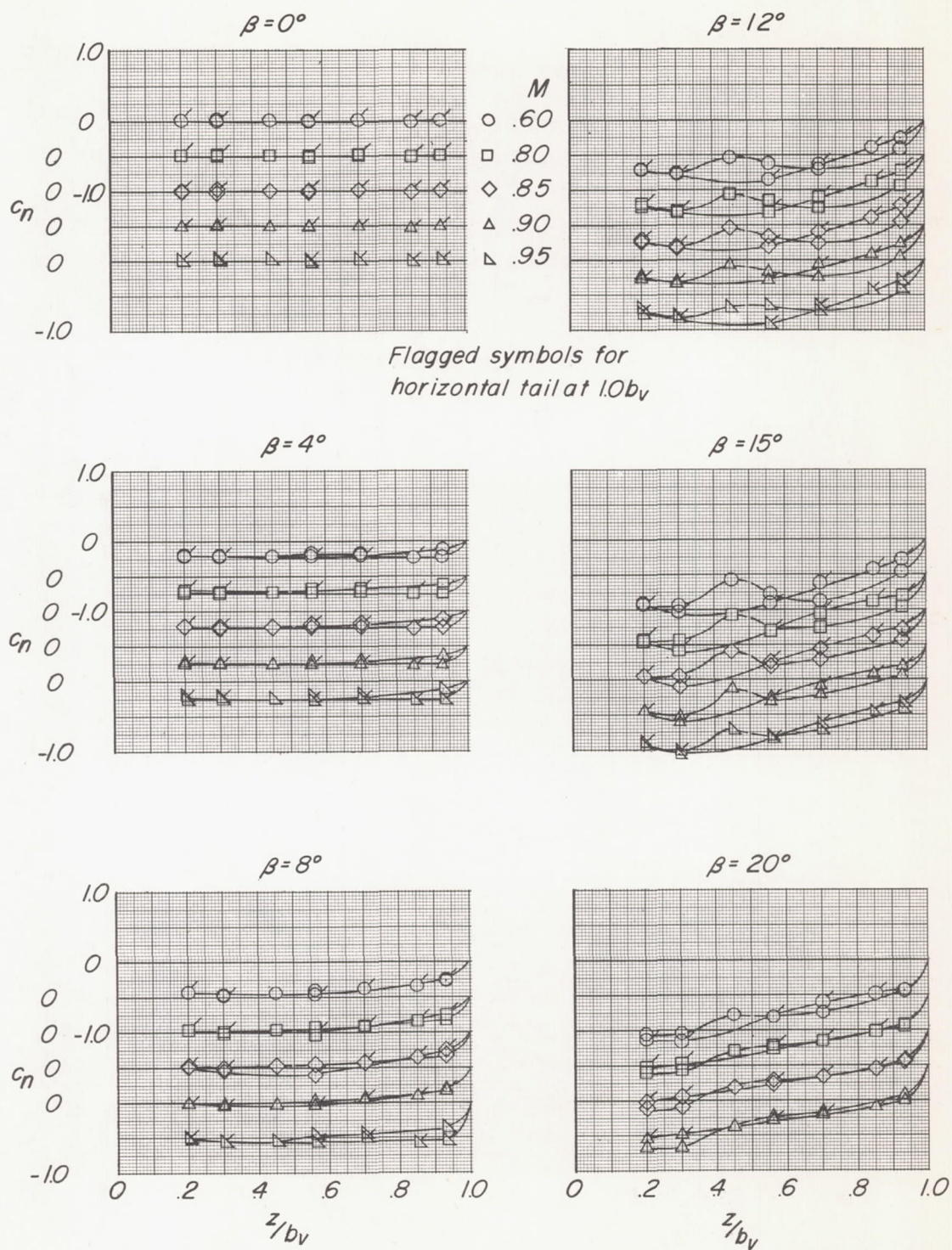


Horizontal tail at $0.5b_v$



Horizontal tail at $1.0b_v$

Figure 6.- Details of effective span segments b' and moment arms l for spanwise integrations to obtain C_N and C_B . (All dimensions in inches.)

(a) $\alpha = 0^\circ$.Figure 7.- Variation of c_n over vertical-tail span for horizontal tail located at $0.5b_v$ and $1.0b_v$.

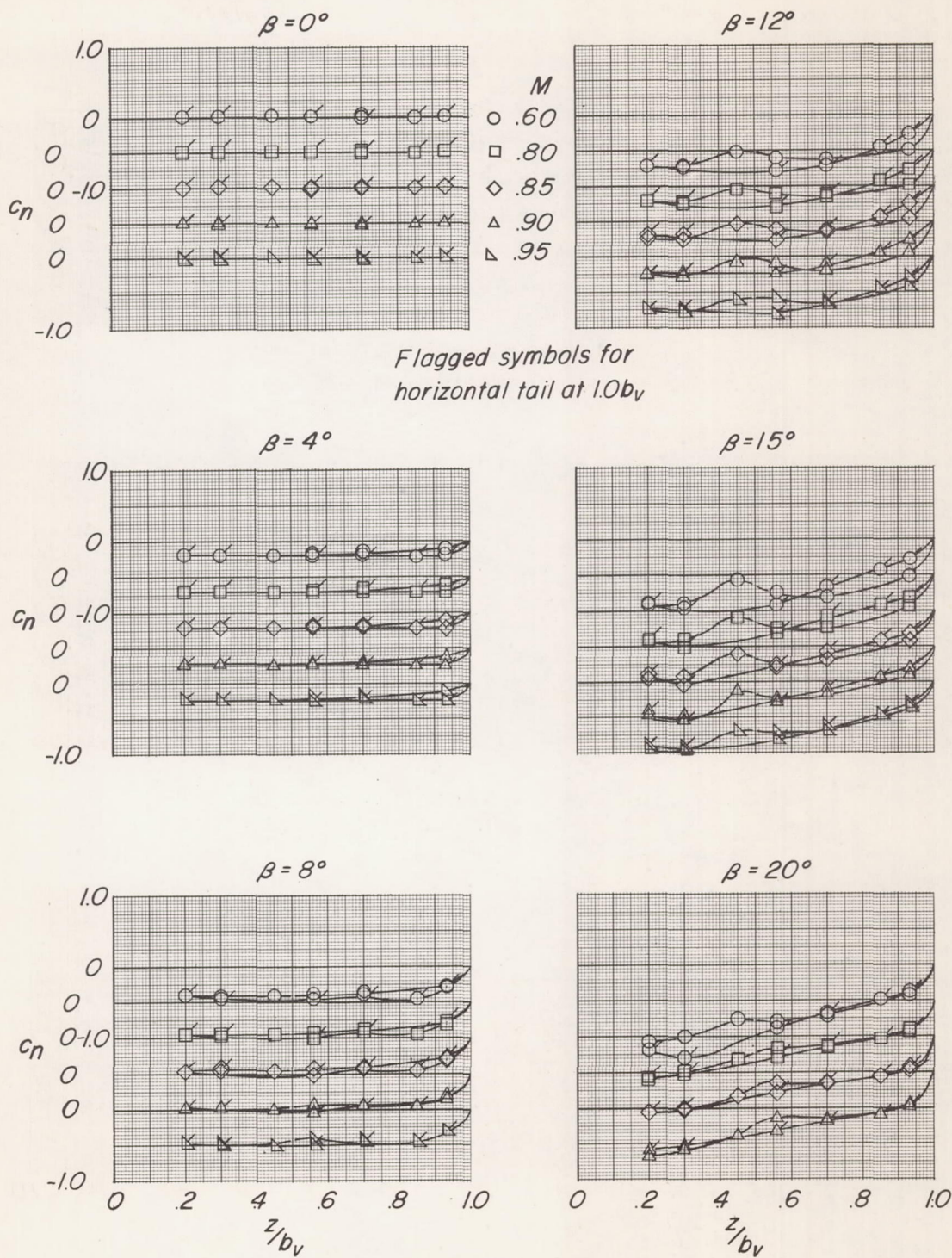
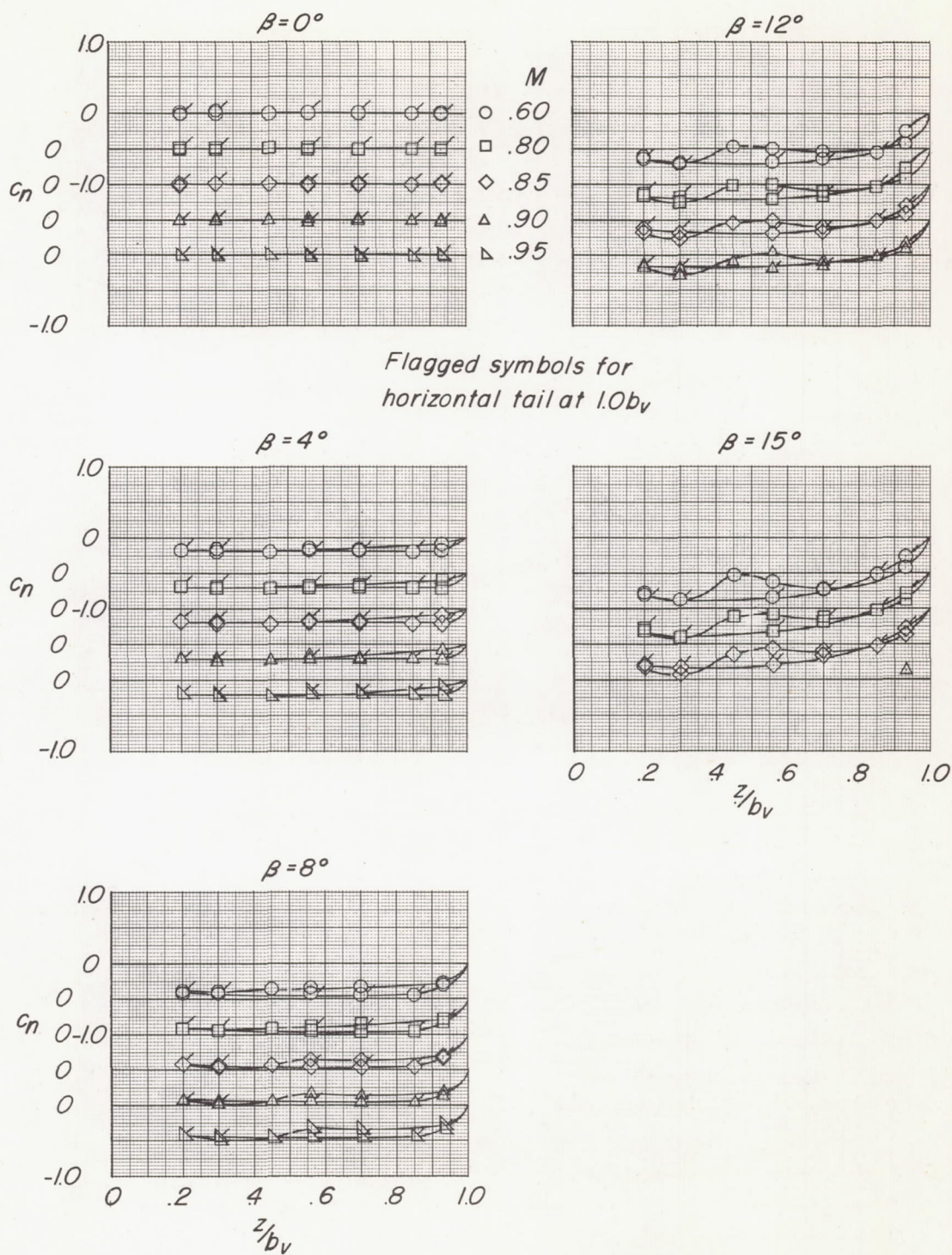


Figure 7.- Continued.



(c) $\alpha = 12^\circ$.

Figure 7.- Concluded.

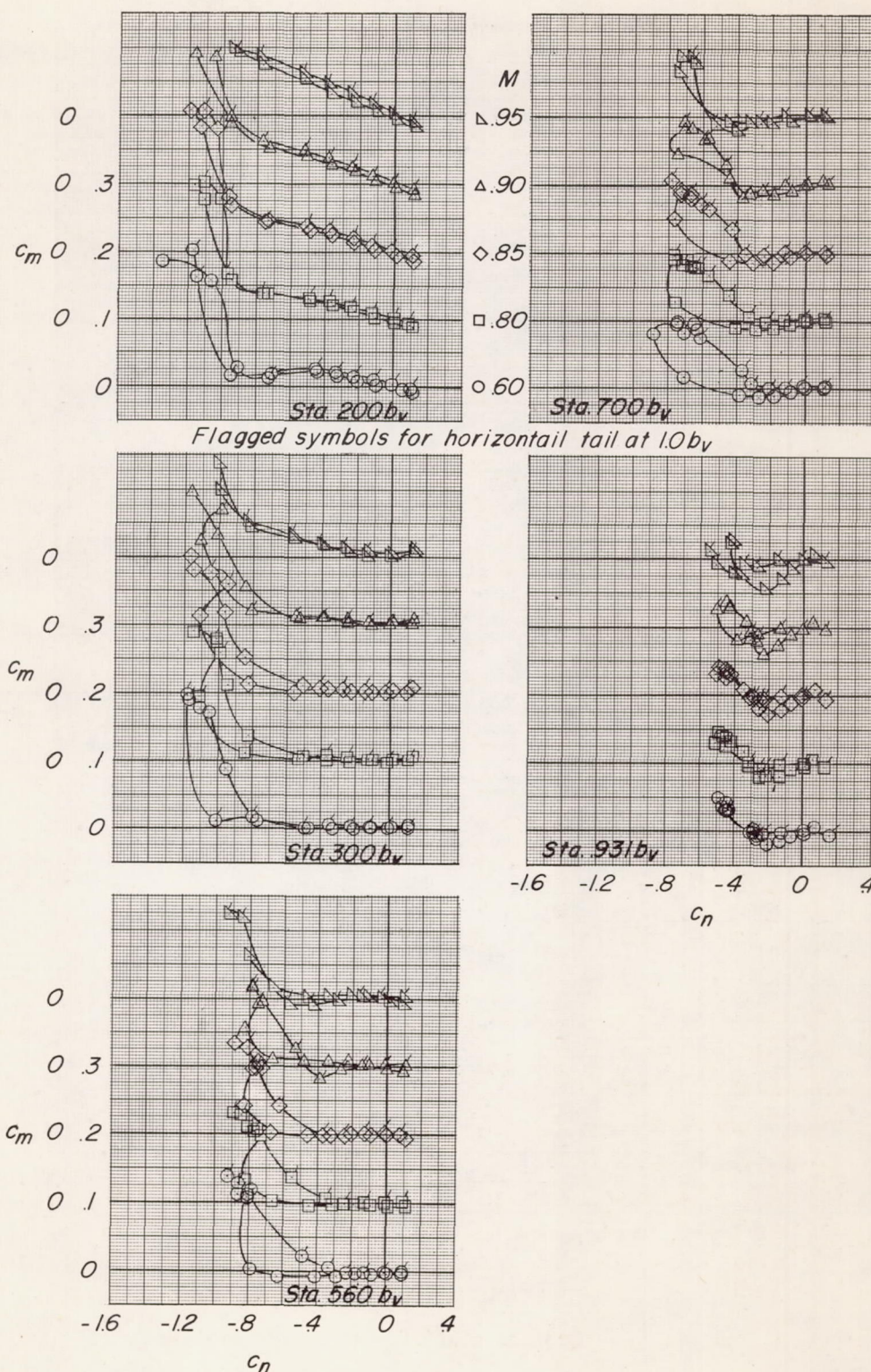
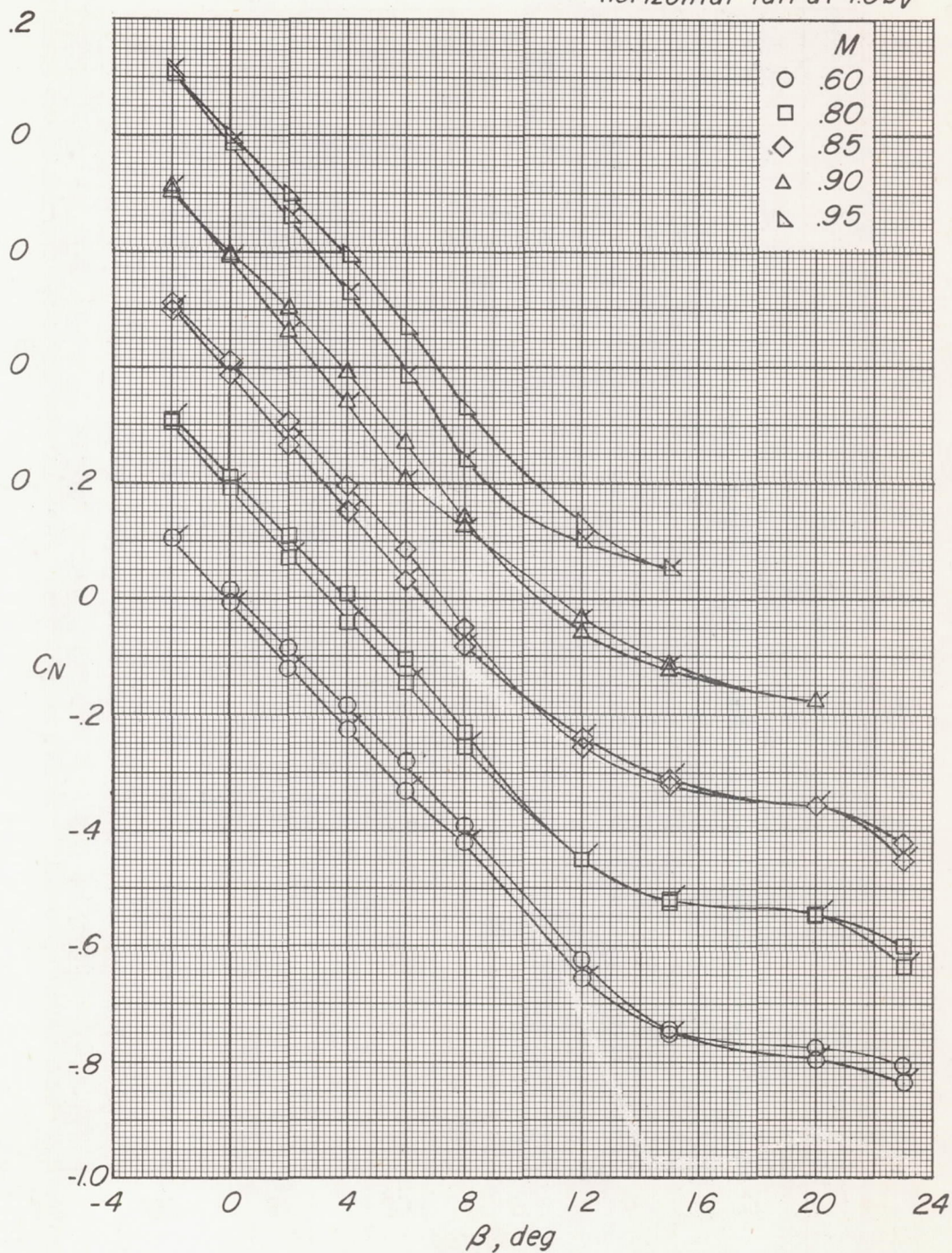


Figure 8.- Variation of section-moment coefficient with section normal-force coefficient at $\alpha = 0^\circ$.

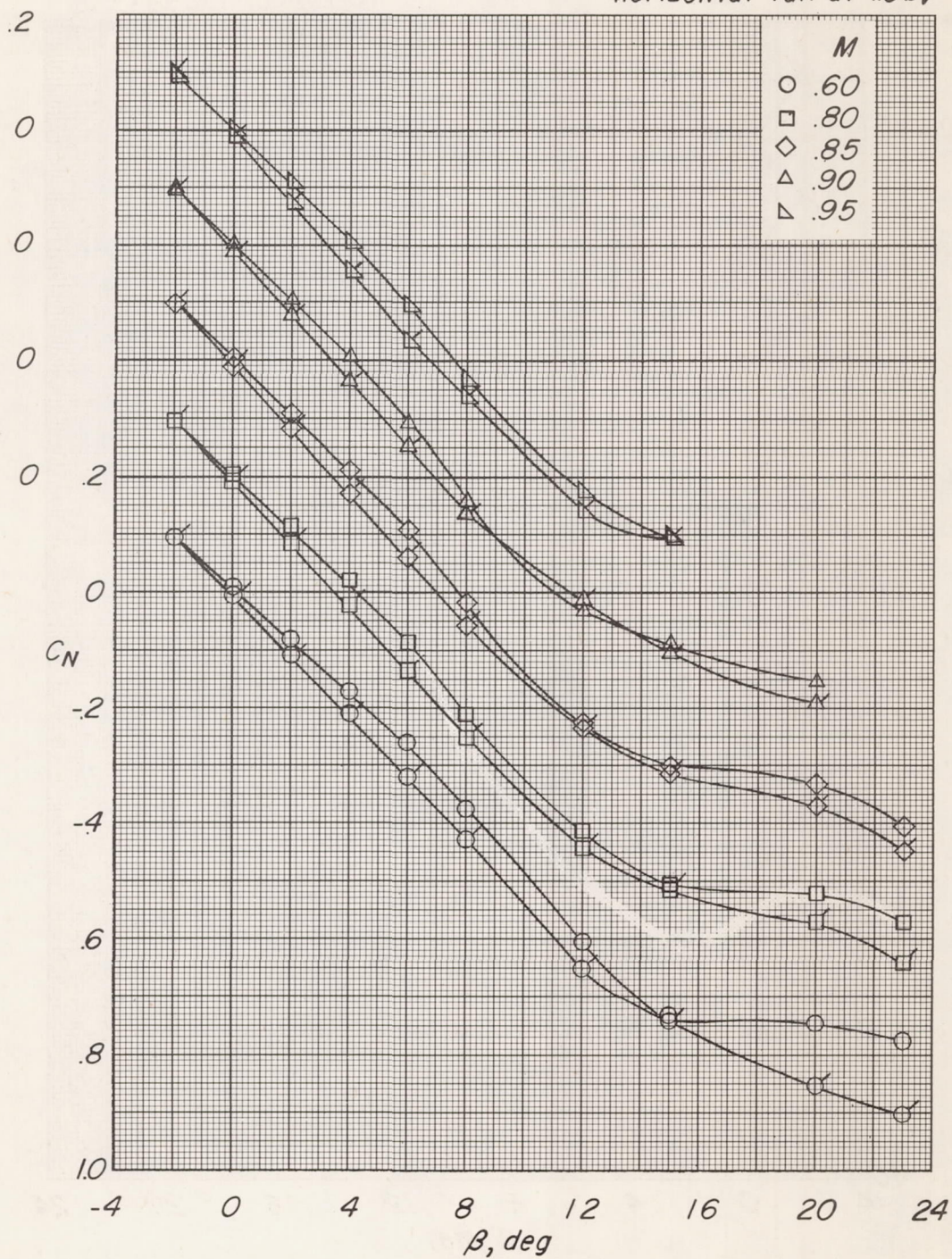
Flagged symbols for
horizontal tail at $1.0b_v$



(a) $\alpha = 0^\circ$.

Figure 9.- Variation of C_N with angle of sideslip for vertical tail with horizontal tail located at $0.5b_v$ and $1.0b_v$.

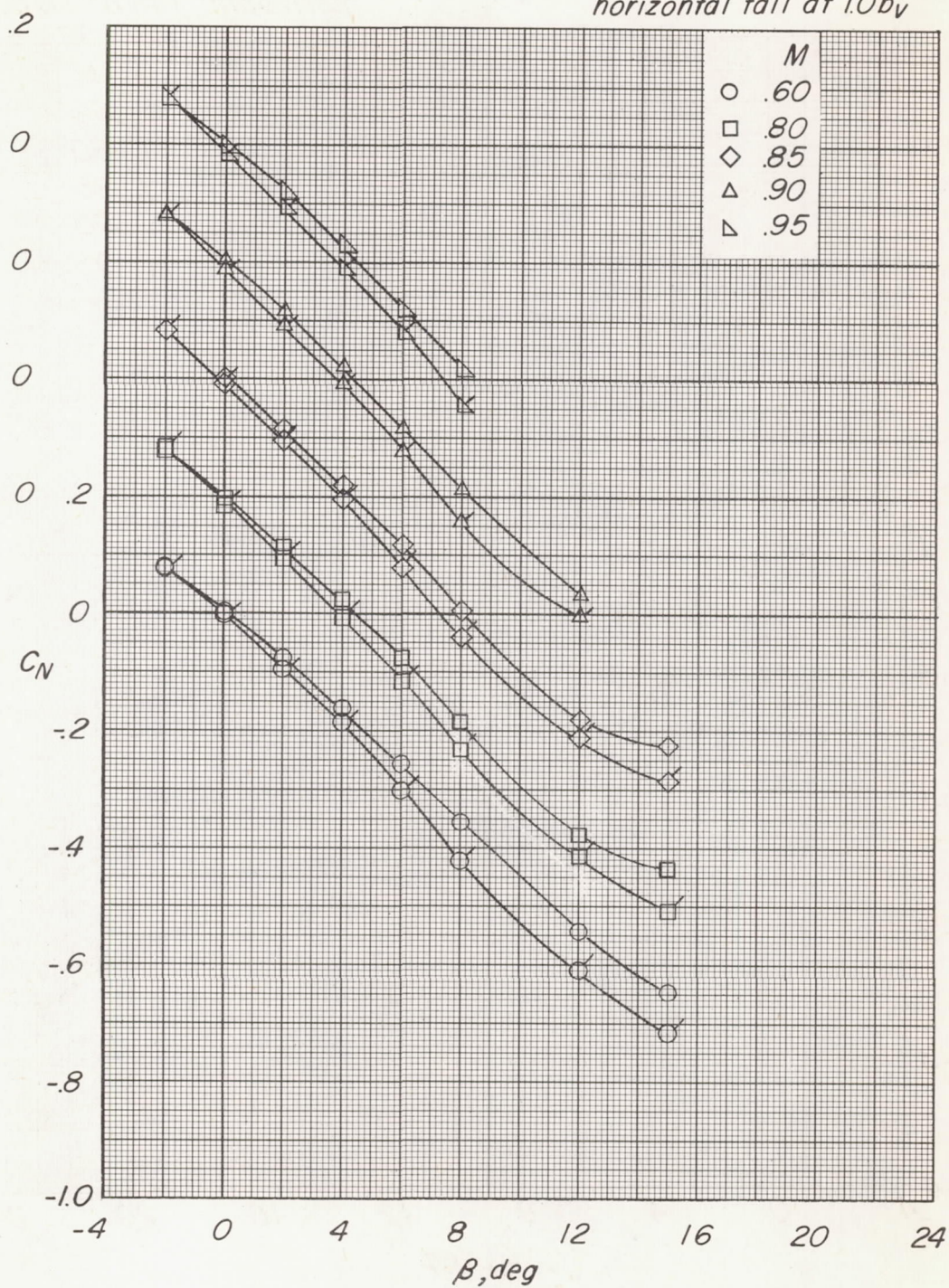
Flagged symbols for
horizontal tail at $1.0b_v$



(b) $\alpha = 4^\circ$.

Figure 9.- Continued.

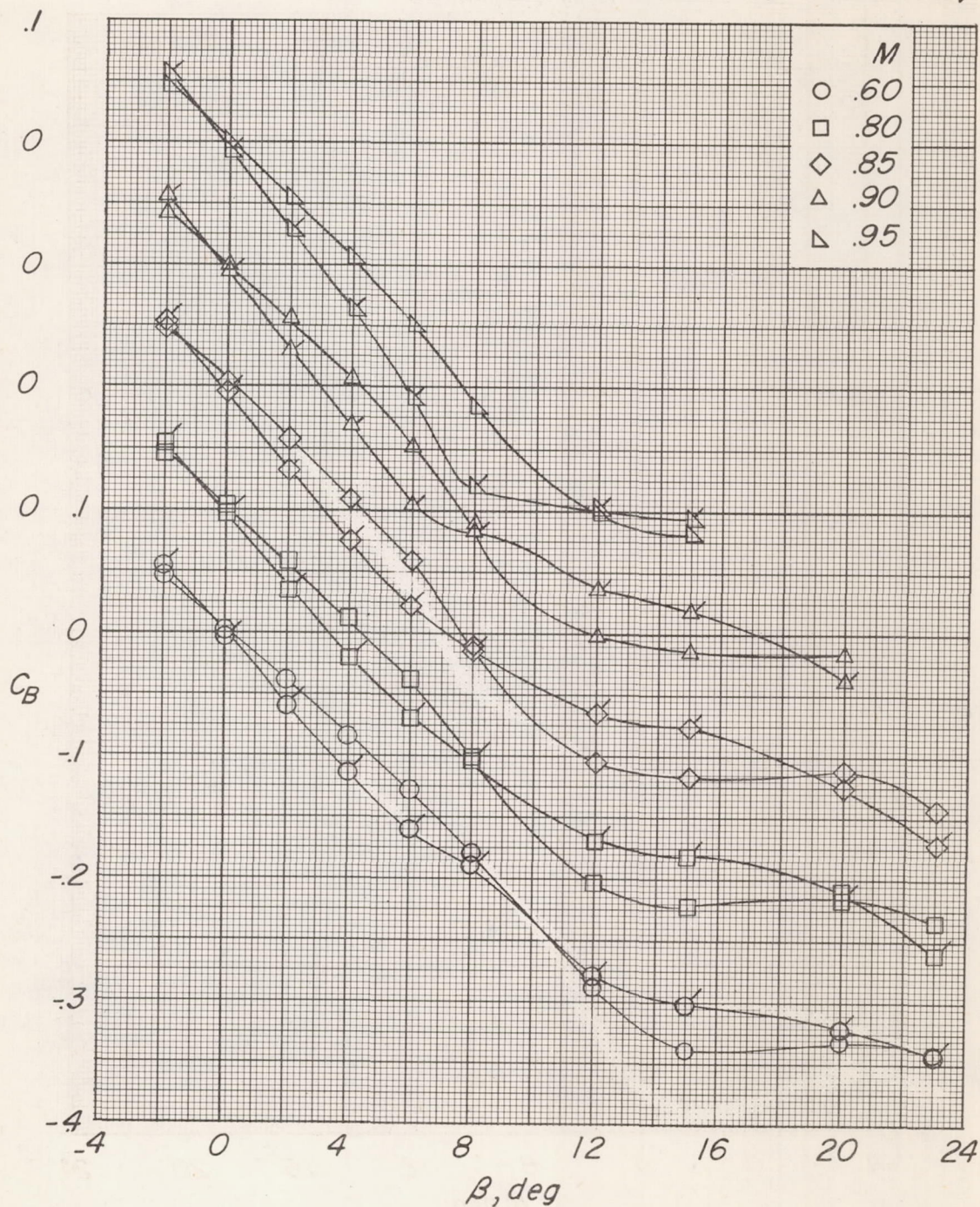
Flagged symbols for
horizontal tail at $1.0b_v$



(c) $\alpha = 12^\circ$.

Figure 9.- Concluded.

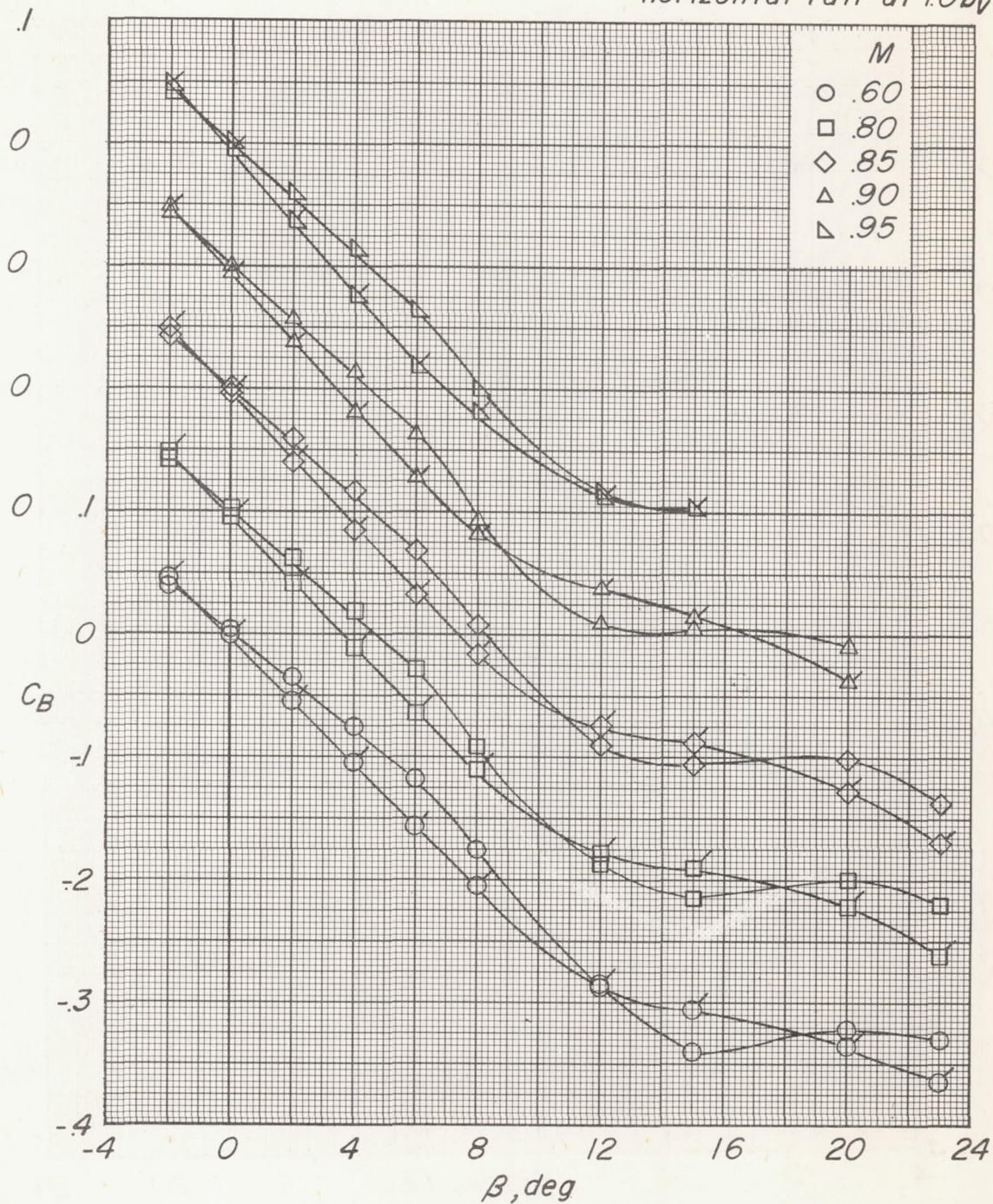
Flagged symbols for
horizontal tail at $1.0b_v$



(a) $\alpha = 0^\circ$.

Figure 10.- Variation of C_B with angle of sideslip for vertical tail with horizontal tail located at $0.5b_v$ and $1.0b_v$.

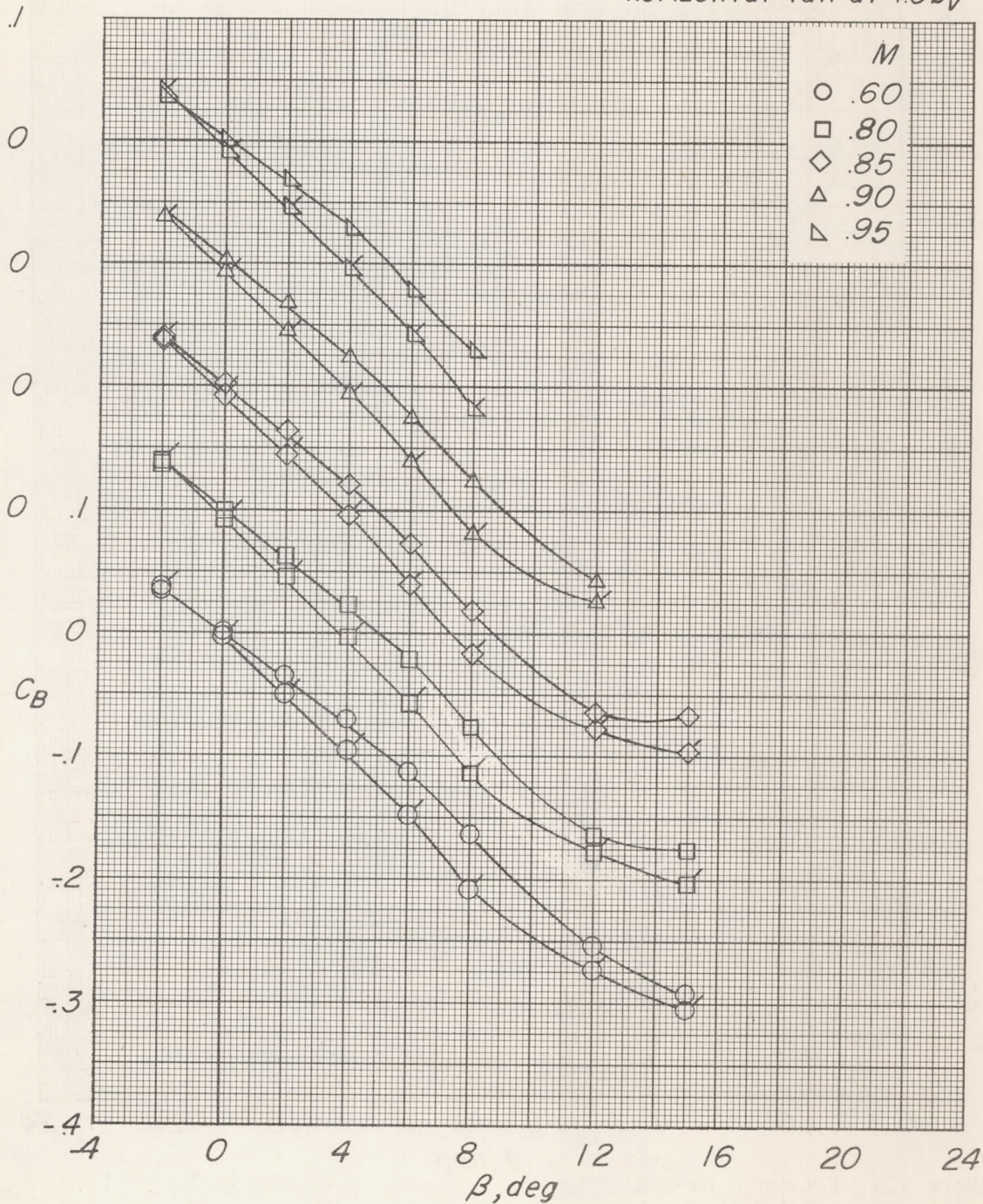
Flagged symbols for
horizontal tail at $1.0b_v$



(b) $\alpha = 4^\circ$.

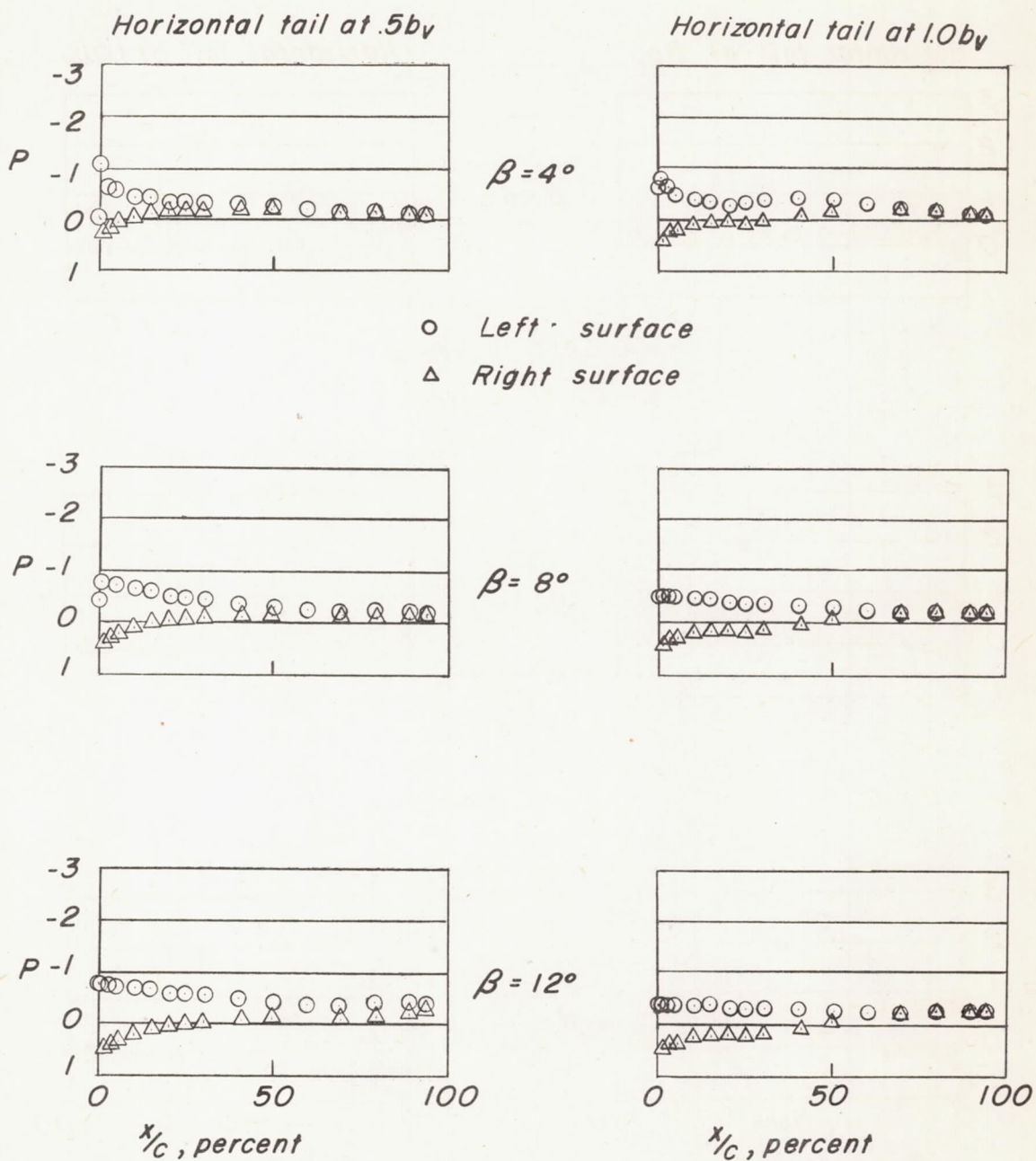
Figure 10.- Continued.

Flagged symbols for
horizontal tail at $1.0b_v$



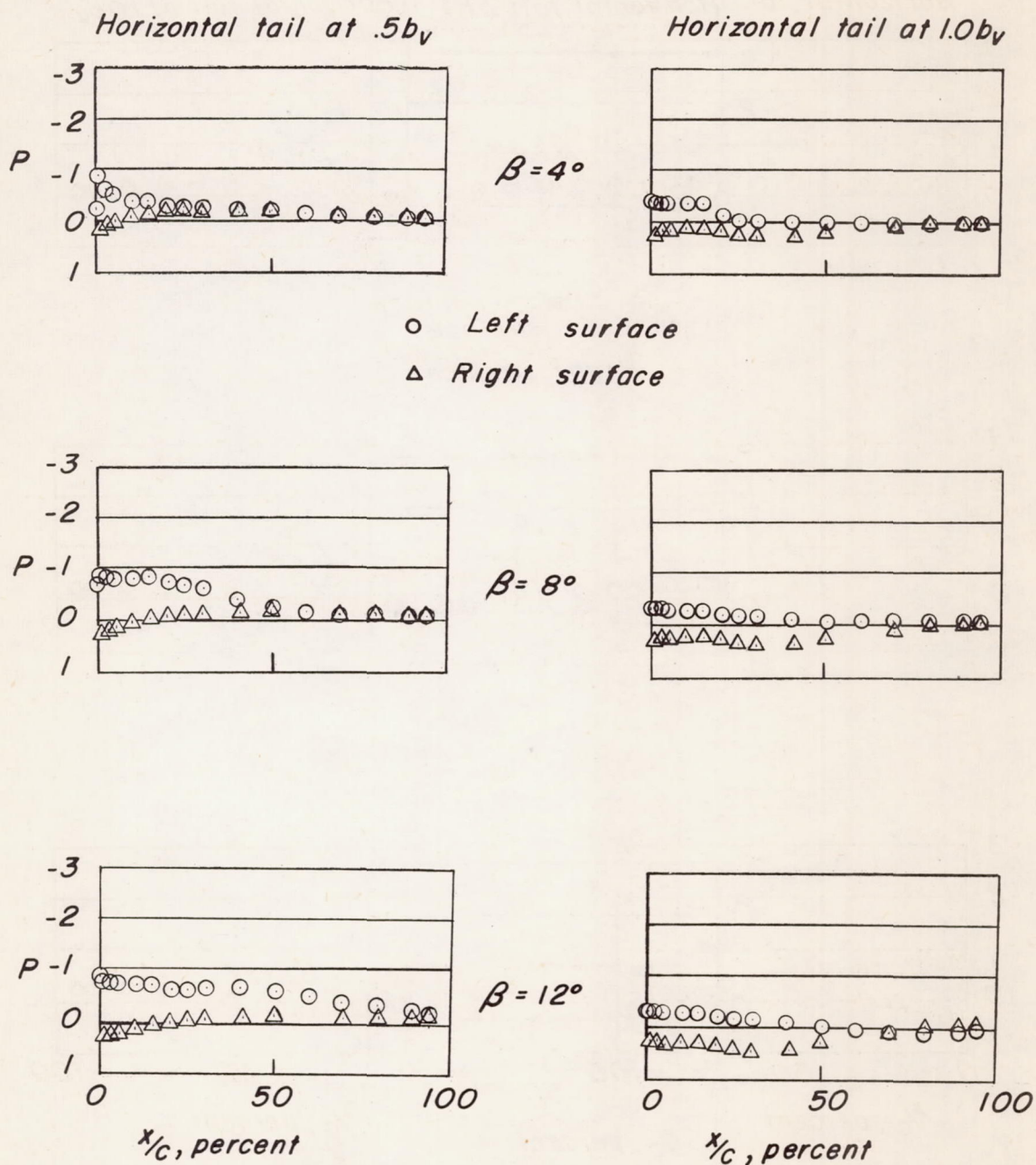
(c) $\alpha = 12^\circ$.

Figure 10.- Concluded.



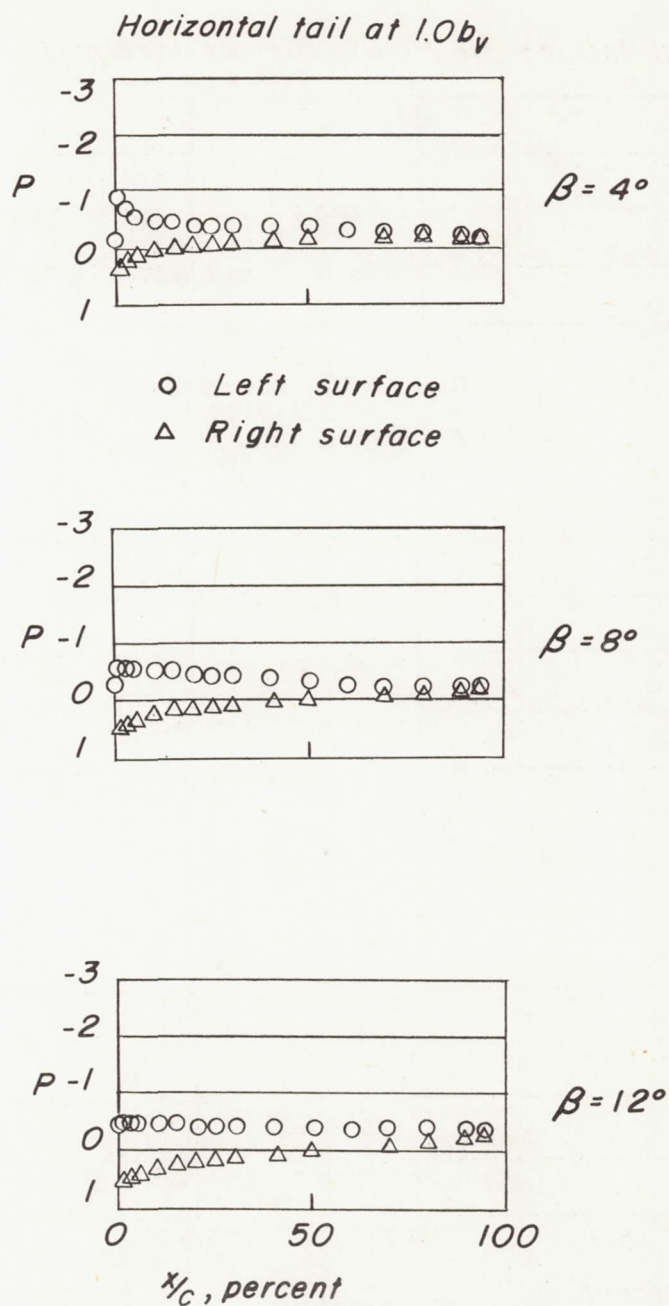
(a) $\alpha = 0^\circ$.

Figure 11.- Pressure distribution on vertical tail. Span station $0.931b_v$; $M = 0.60$.



(b) $\alpha = 12^\circ$.

Figure 11.- Concluded.



(a) $\alpha = 0^\circ$.

Figure 12.- Pressure distribution on vertical tail. Span station $0.850b_v$;
 $M = 0.60$.

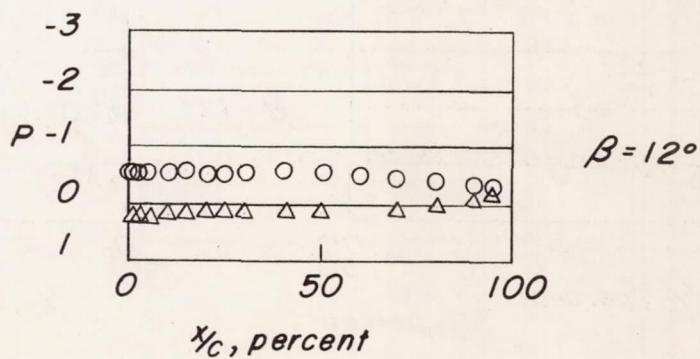
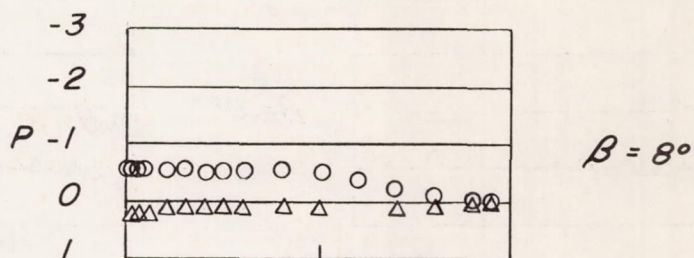
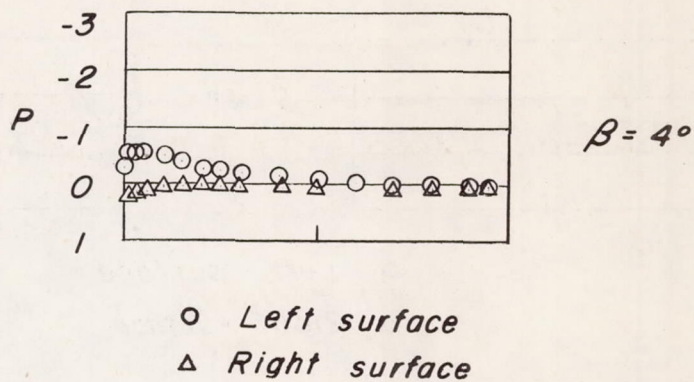
Horizontal tail at $1.0b_v$ (b) $\alpha = 12^\circ$.

Figure 12.- Concluded.

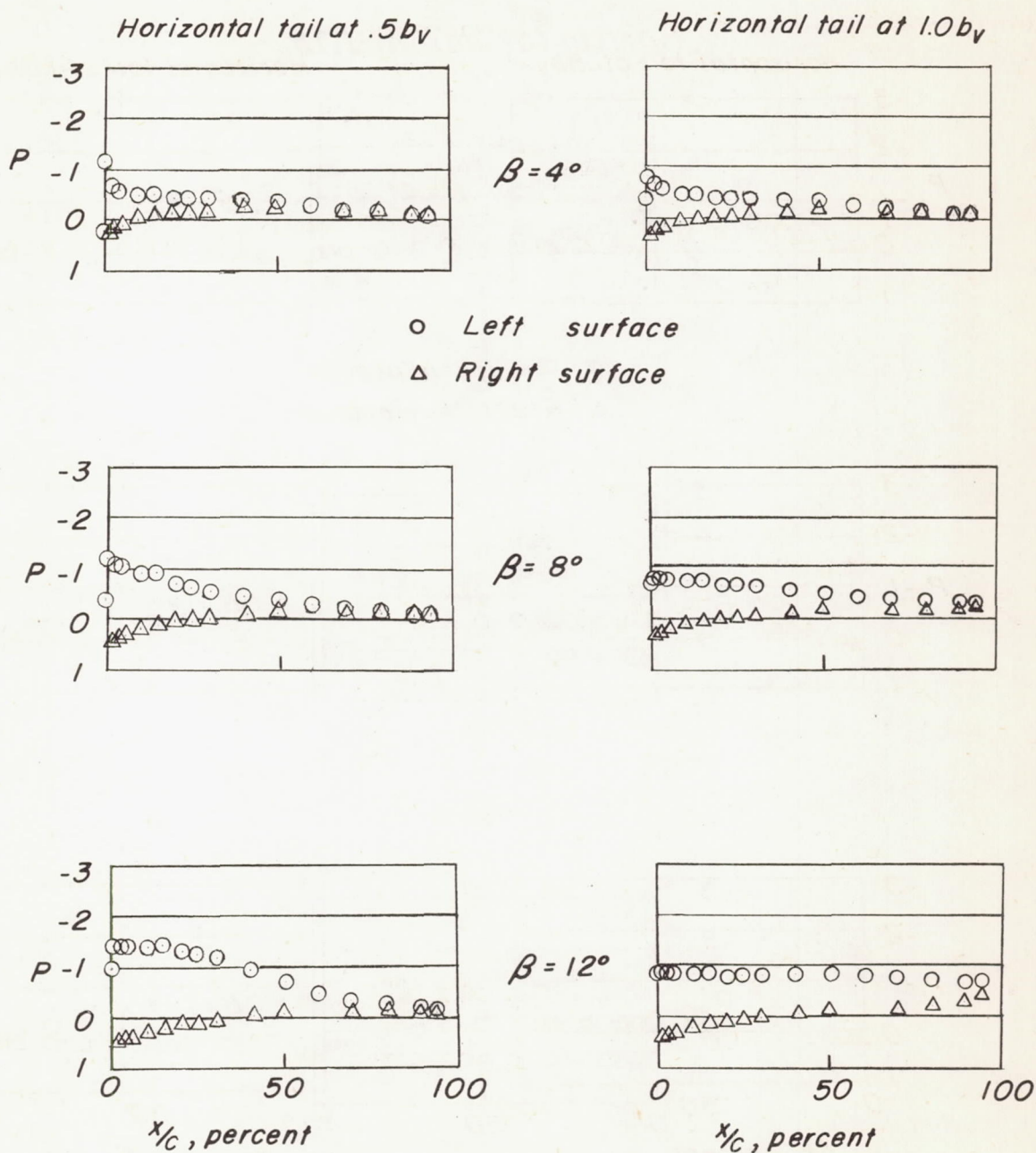
(a) $\alpha = 0^\circ$.

Figure 13.- Pressure distribution on vertical tail. Span station $0.700b_v$;
 $M = 0.60$.

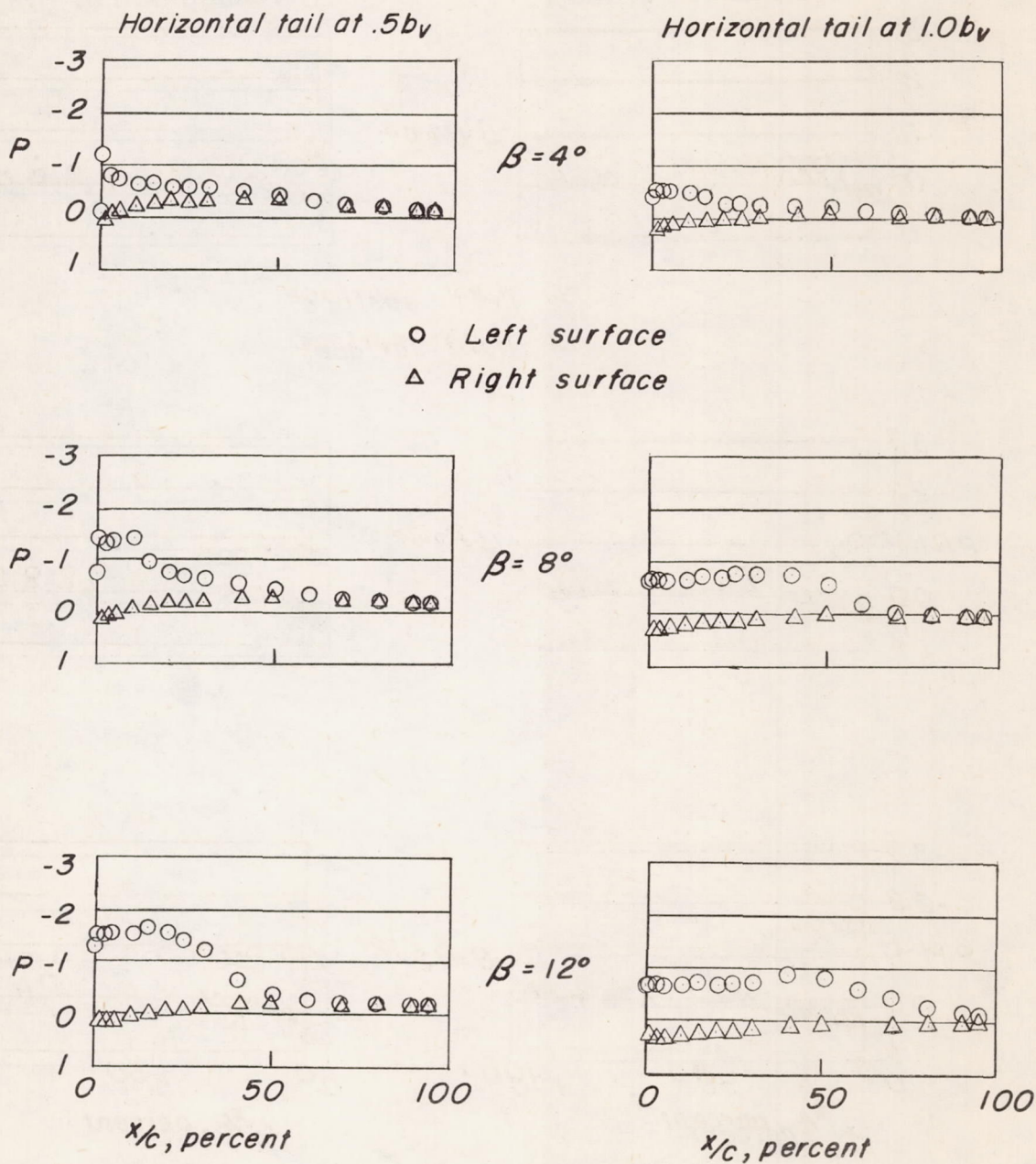
(b) $\alpha = 12^\circ$.

Figure 13.- Concluded.

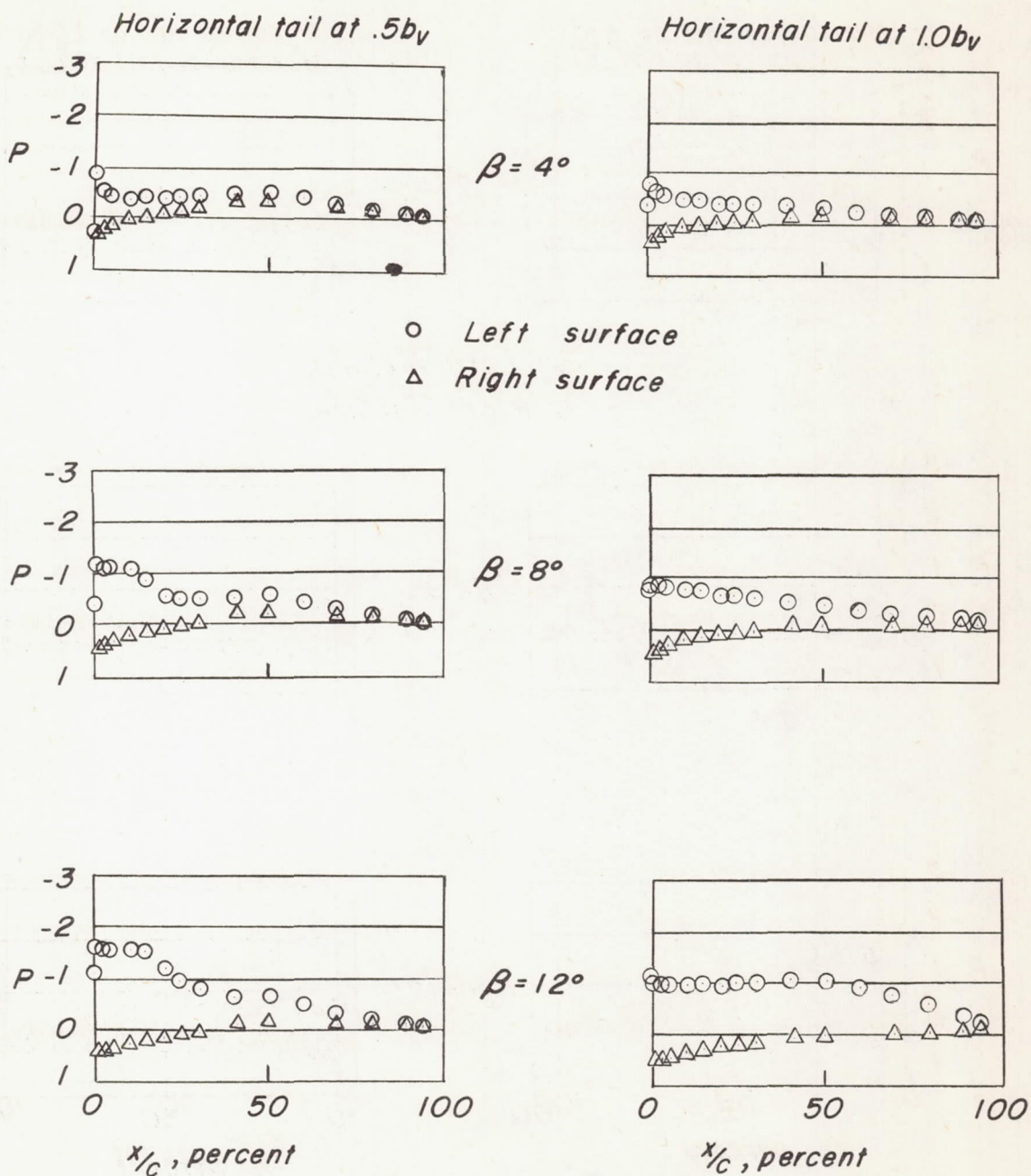
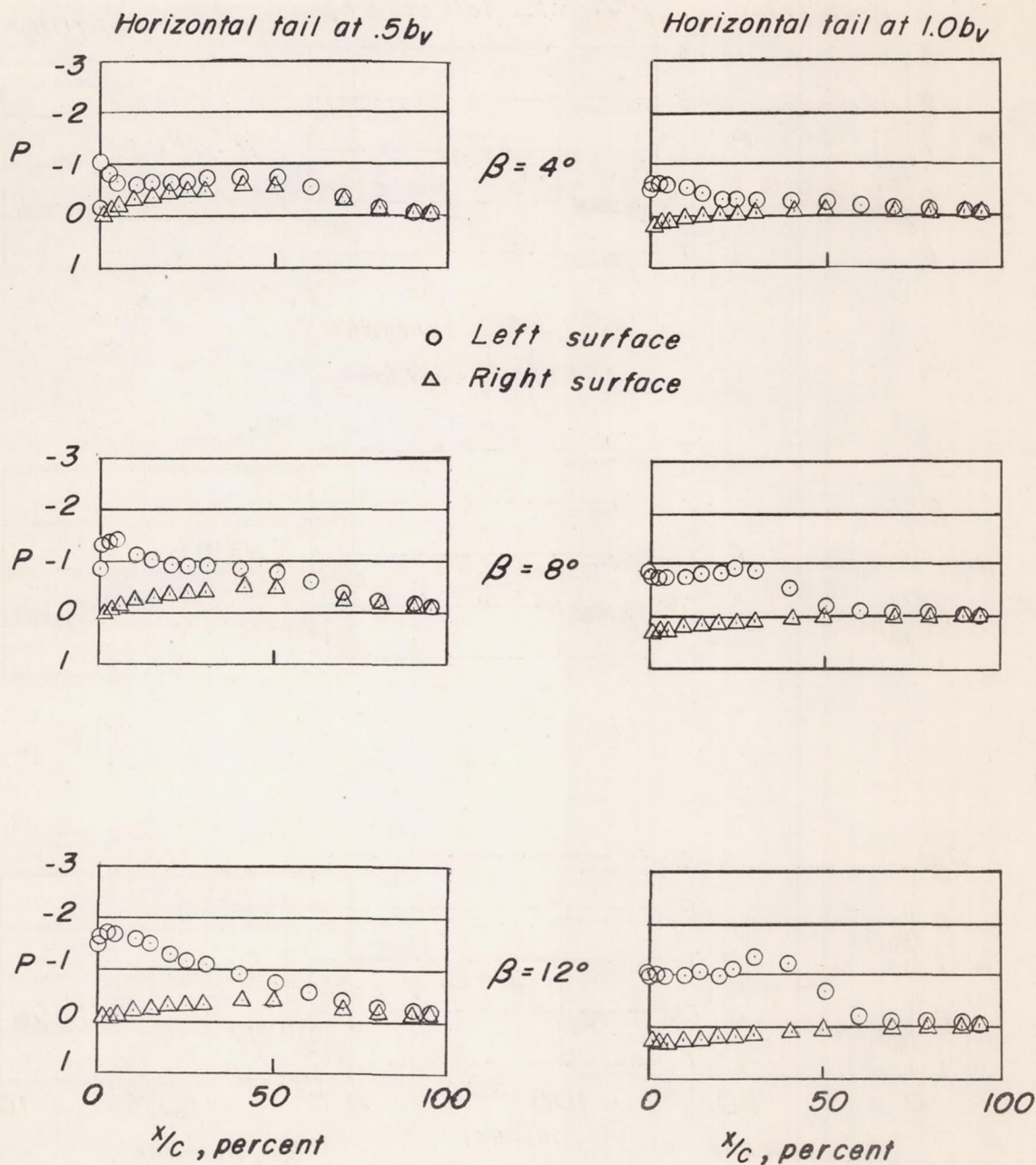
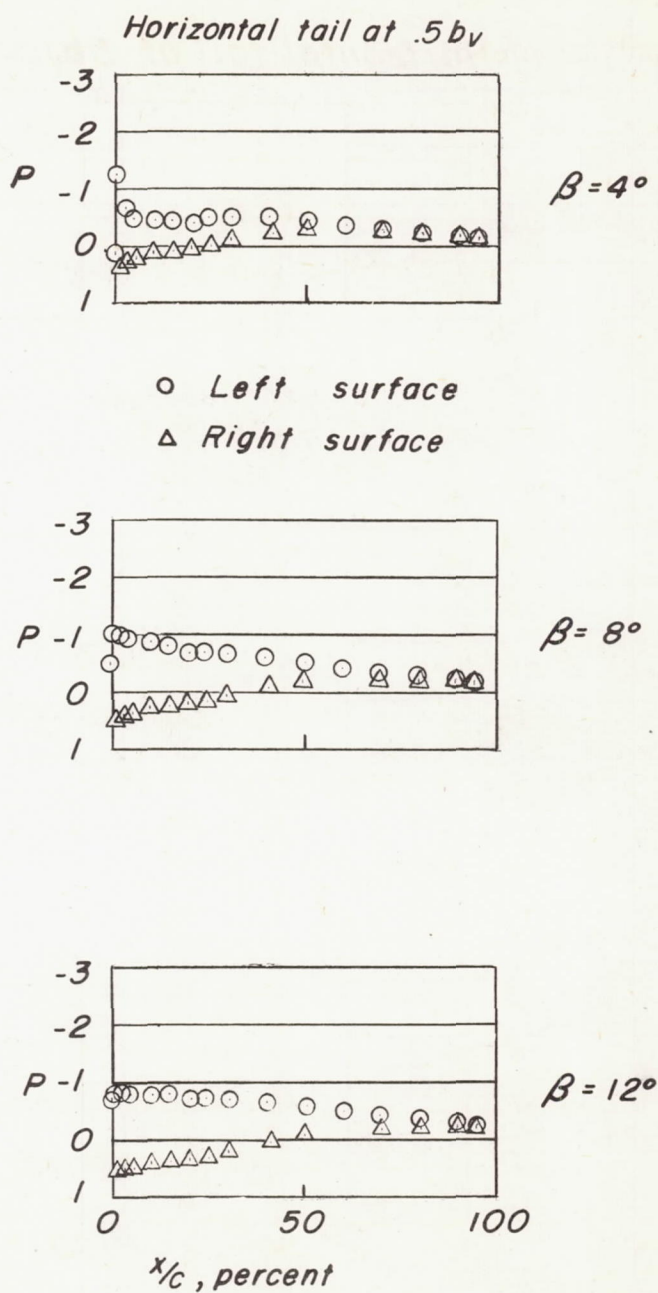
(a) $\alpha = 0^\circ$.

Figure 14.- Pressure distribution on vertical tail. Span station $0.560b_v$;
 $M = 0.60$.



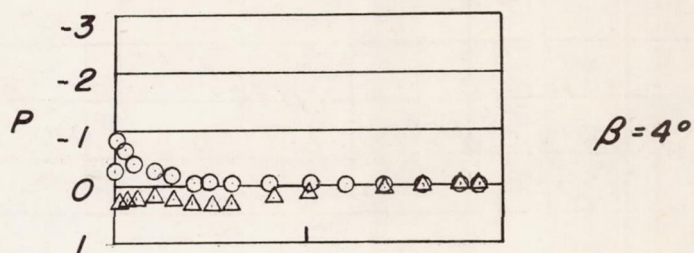
(b) $\alpha = 12^\circ$.

Figure 14.- Concluded.

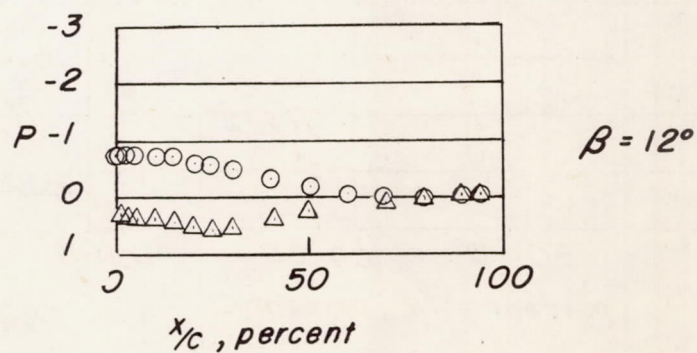
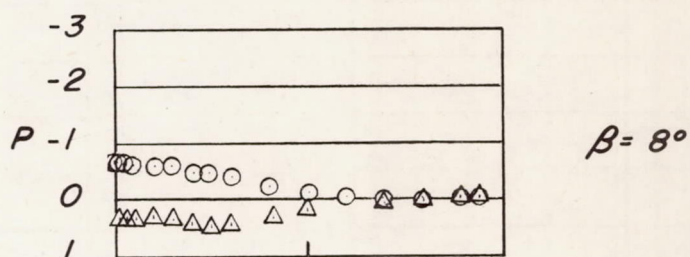


(a) $\alpha = 0^\circ$.

Figure 15.- Pressure distribution on vertical tail. Span station 0.450;
M = 0.60.

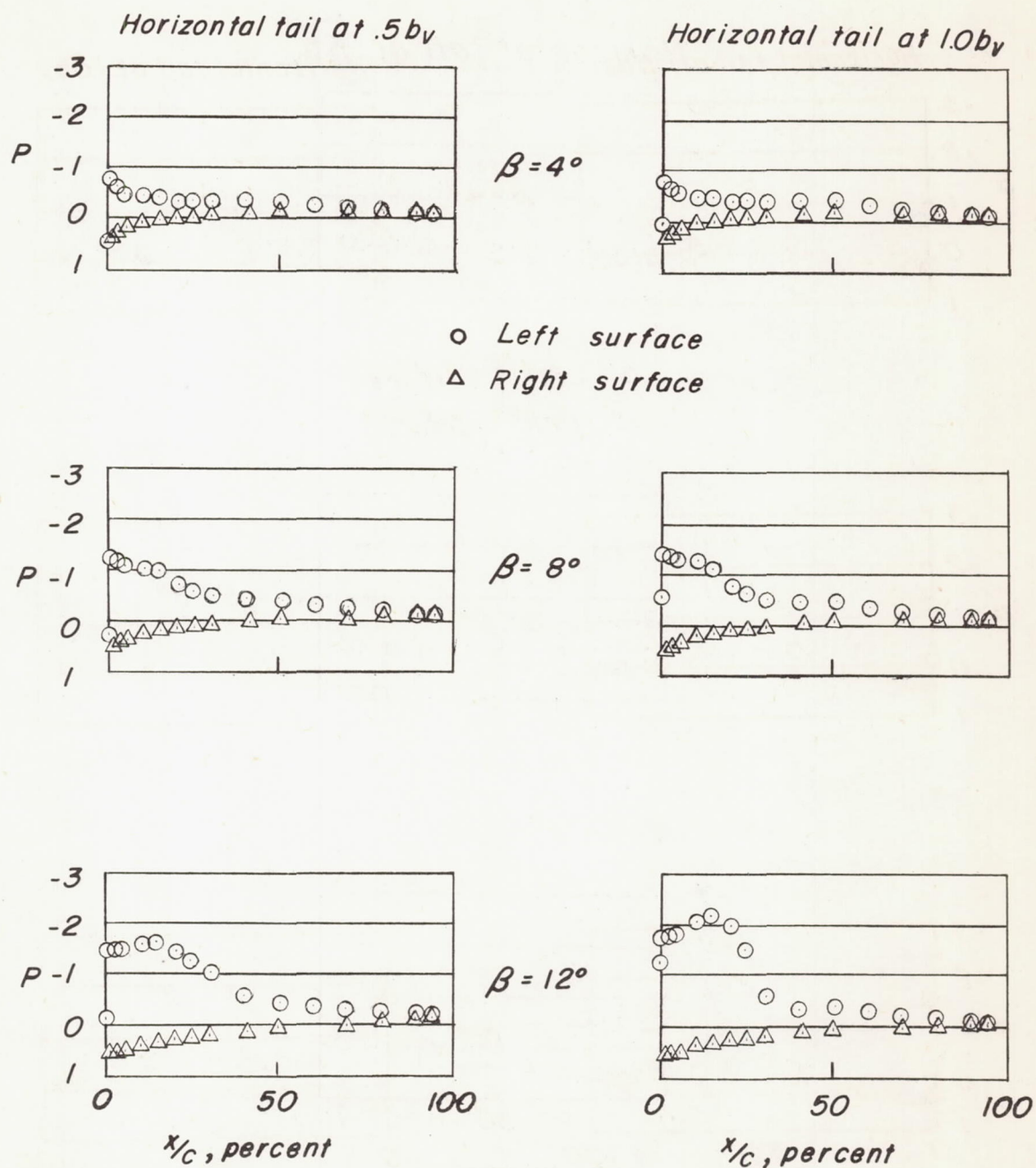
Horizontal tail at .5b_v

○ Left surface
△ Right surface



(b) $\alpha = 12^\circ$.

Figure 15.- Concluded.



(a) $\alpha = 0^\circ$.

Figure 16.- Pressure distribution on vertical tail. Span station 0.300;
M = 0.60.

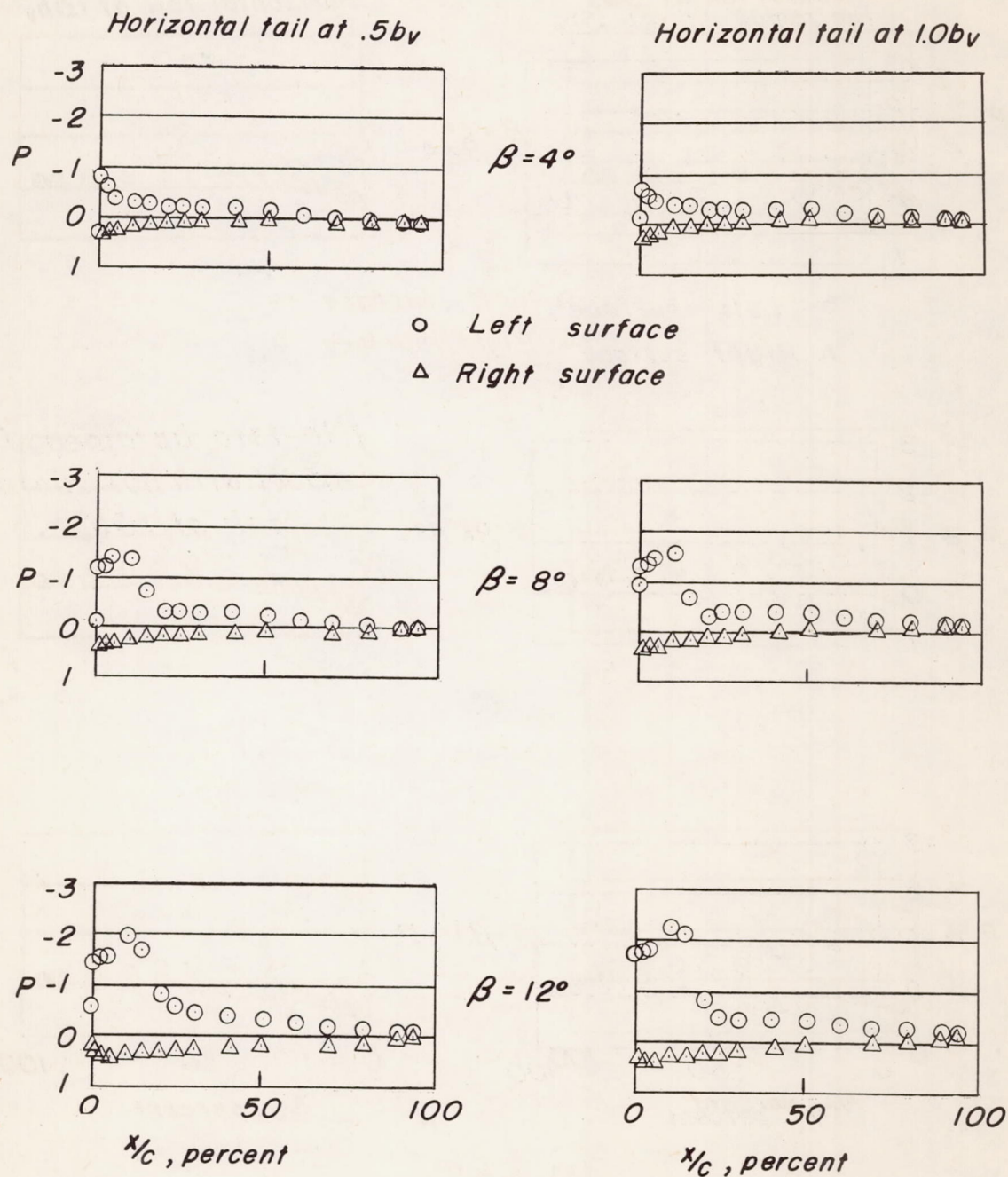
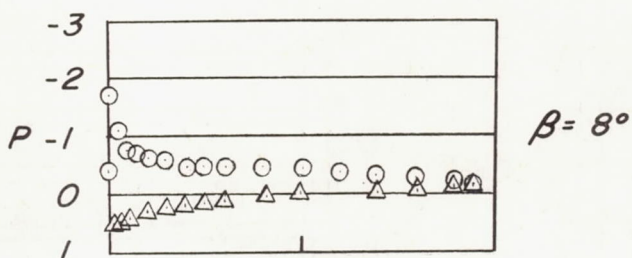
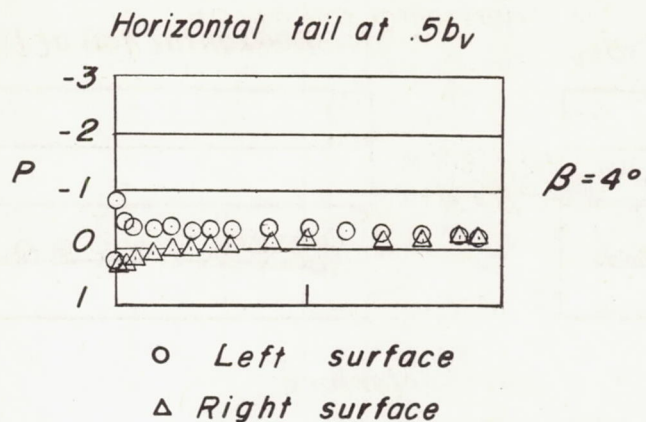
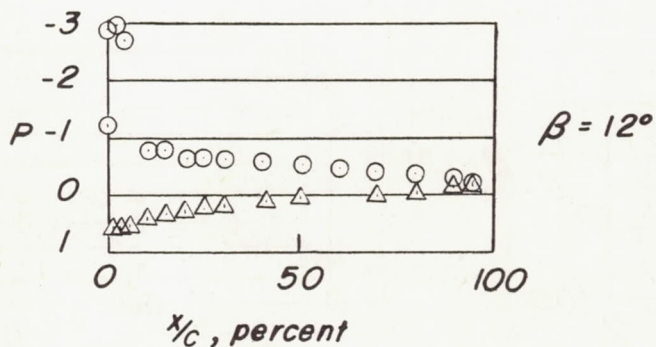
(b) $\alpha = 12^\circ$.

Figure 16.- Concluded.



*(No data obtained for
model with horizontal
tail at $1.0b_v$)*



(a) $\alpha = 0^\circ$.

Figure 17.- Pressure distribution on vertical tail. Span station 0.200;
 $M = 0.60$.

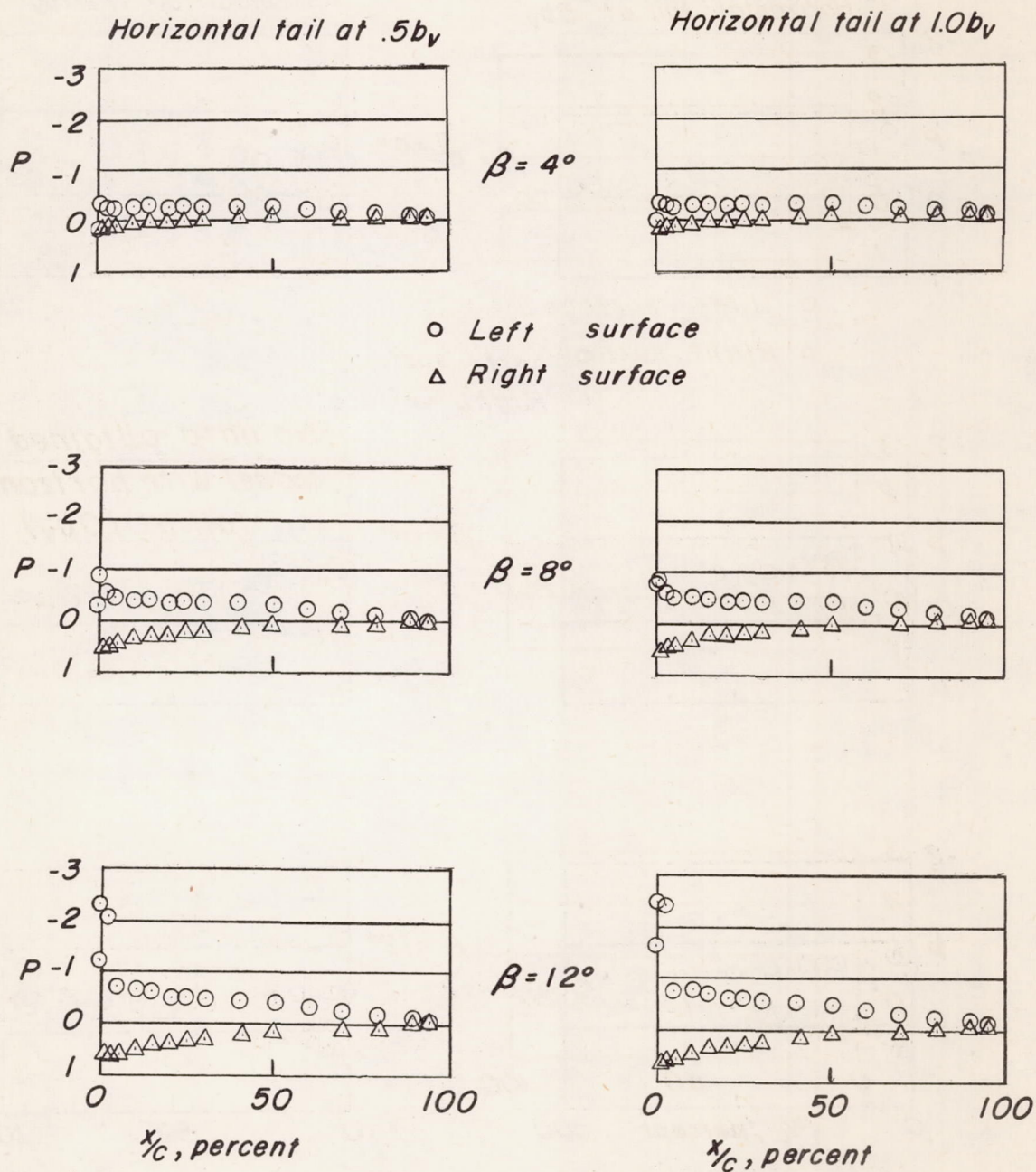
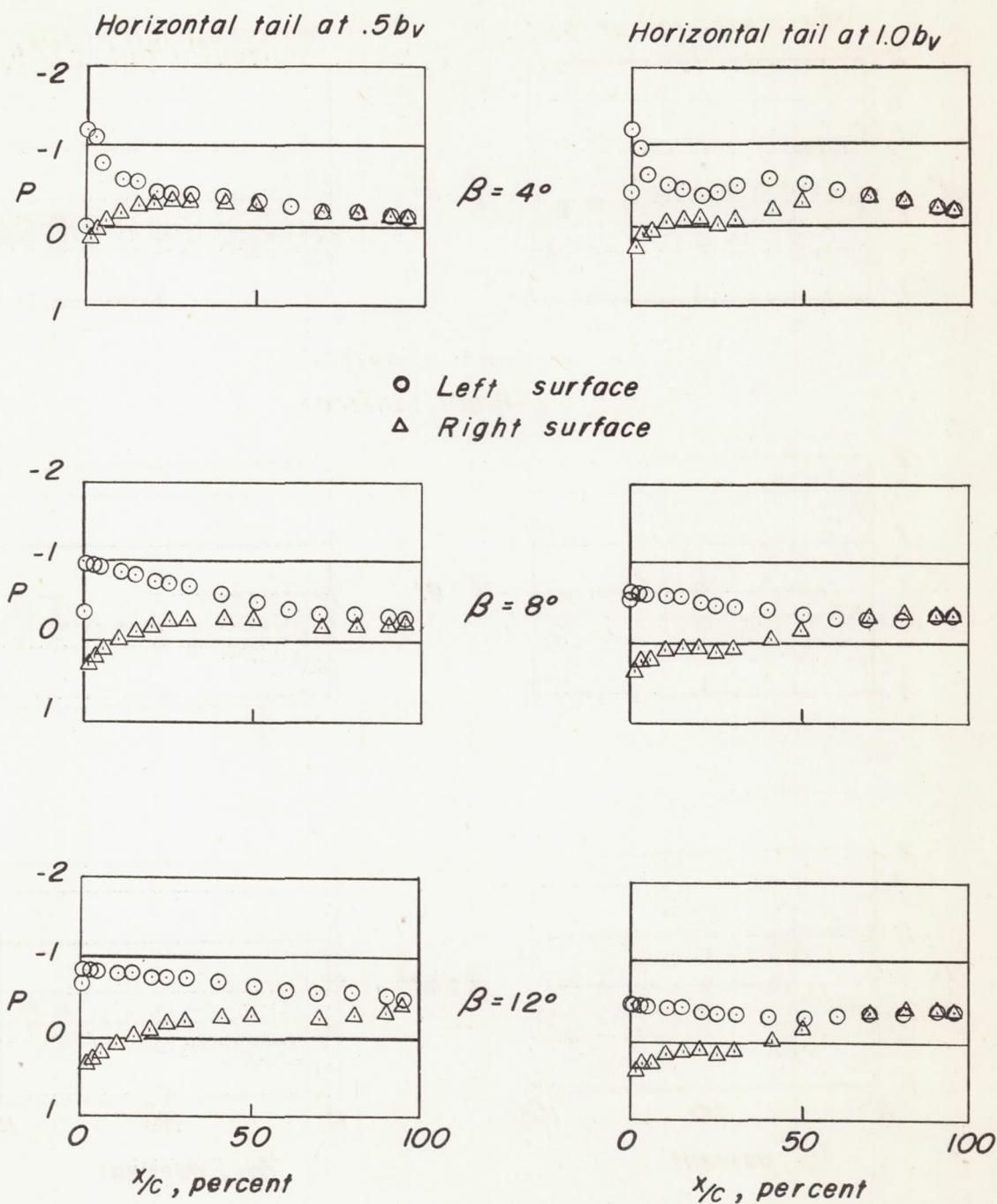
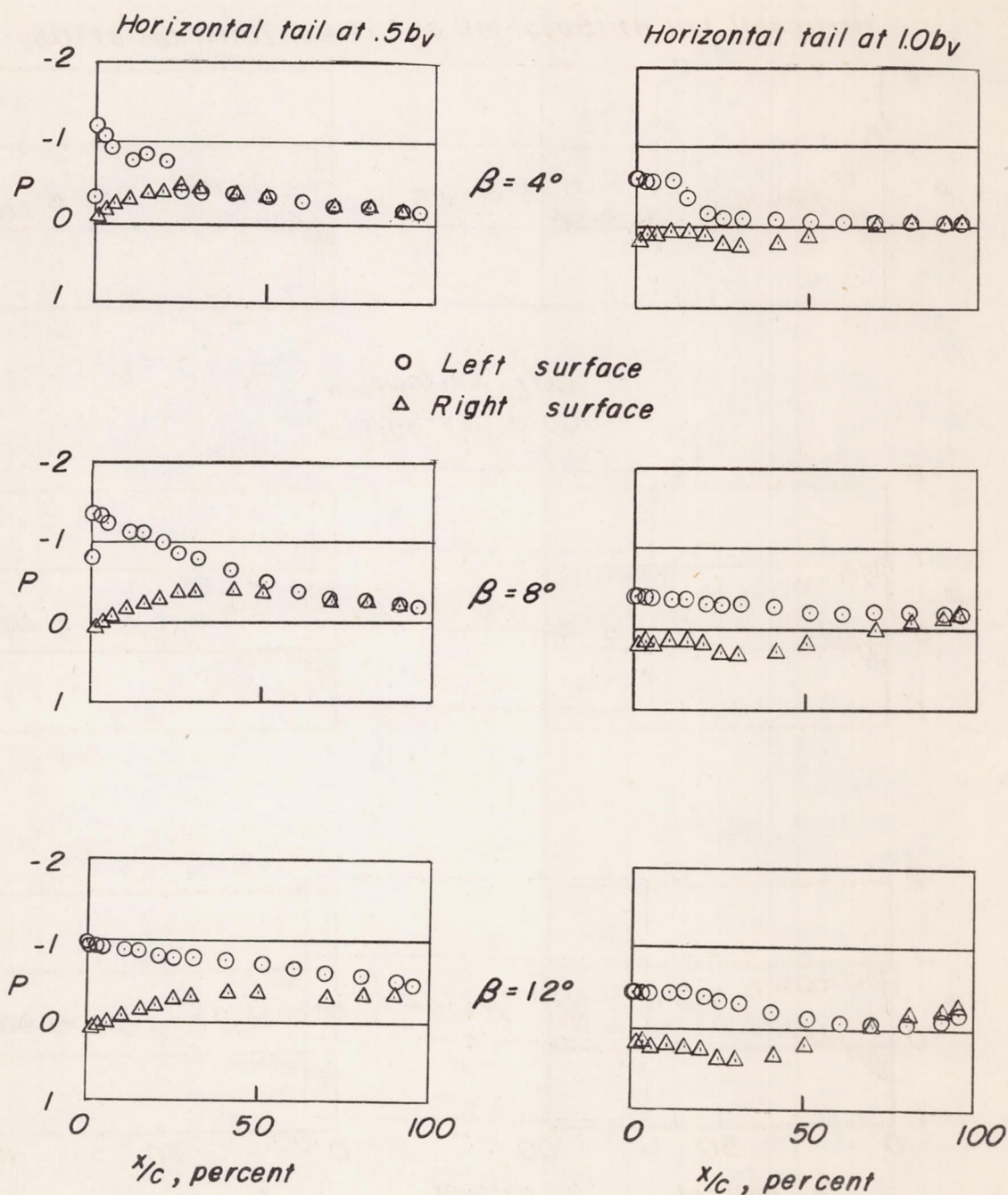
(b) $\alpha = 12^\circ$.

Figure 17.- Concluded.



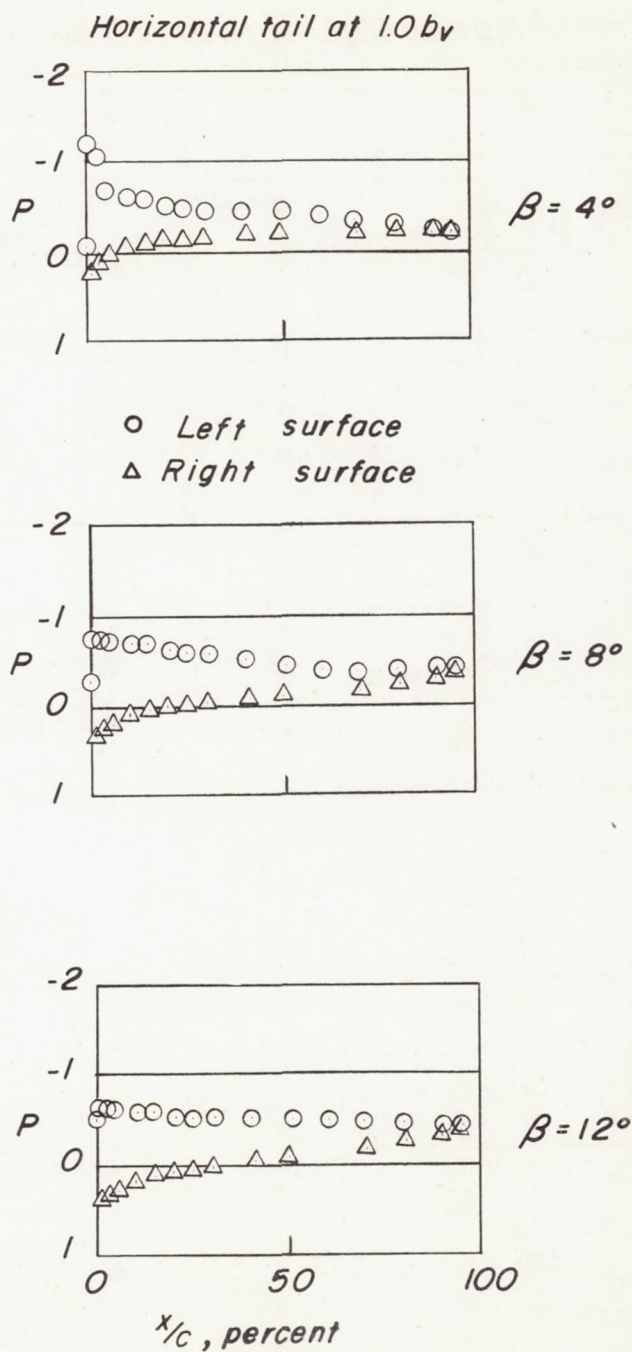
(a) $\alpha = 0^\circ$.

Figure 18.- Pressure distribution on vertical tail. Span station $0.931b_v$; $M = 0.85$.



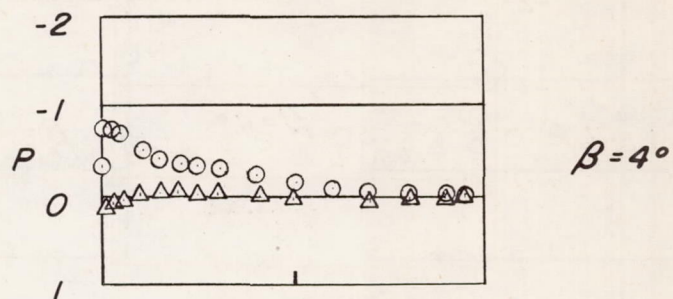
(b) $\alpha = 12^\circ$.

Figure 18.- Concluded.

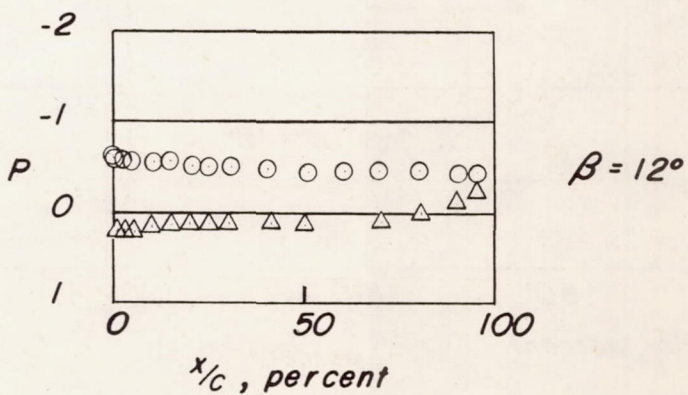
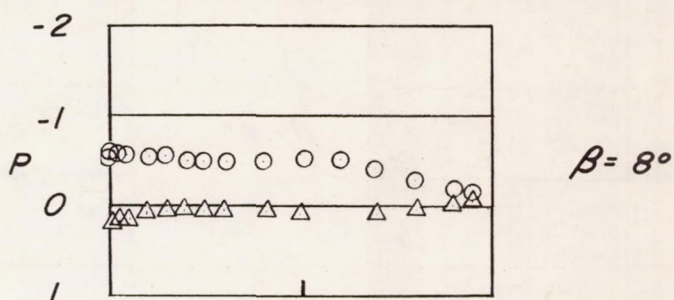


(a) $\alpha = 0^\circ$.

Figure 19.- Pressure distribution on vertical tail. Span station 0.850;
M = 0.85.

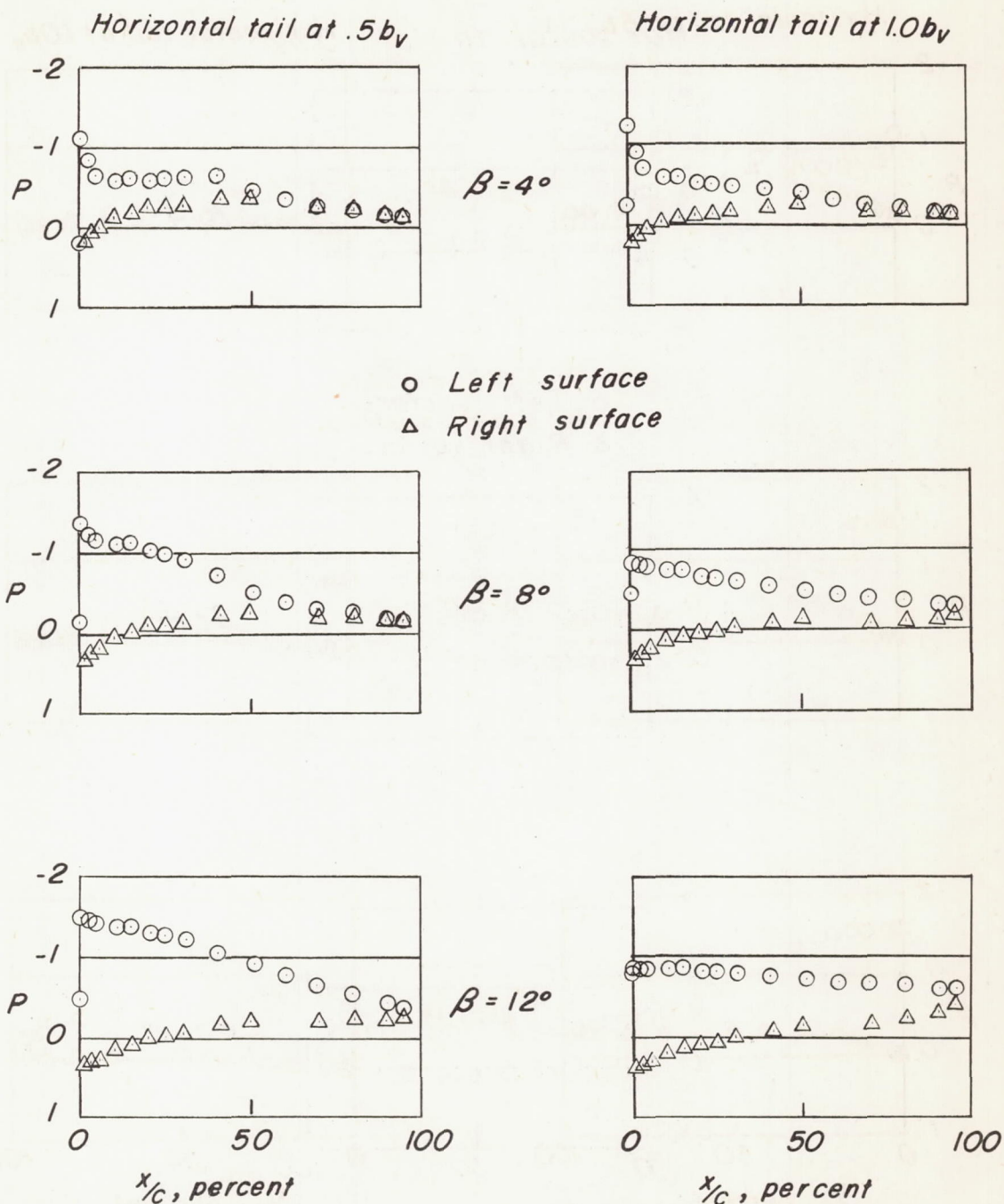
Horizontal tail at 1.0 bv

○ Left surface
△ Right surface



(b) $\alpha = 12^\circ$.

Figure 19.- Concluded.



(a) $\alpha = 0^\circ$.

Figure 20.- Pressure distribution on vertical tail. Span station 0.700;
 $M = 0.85$.

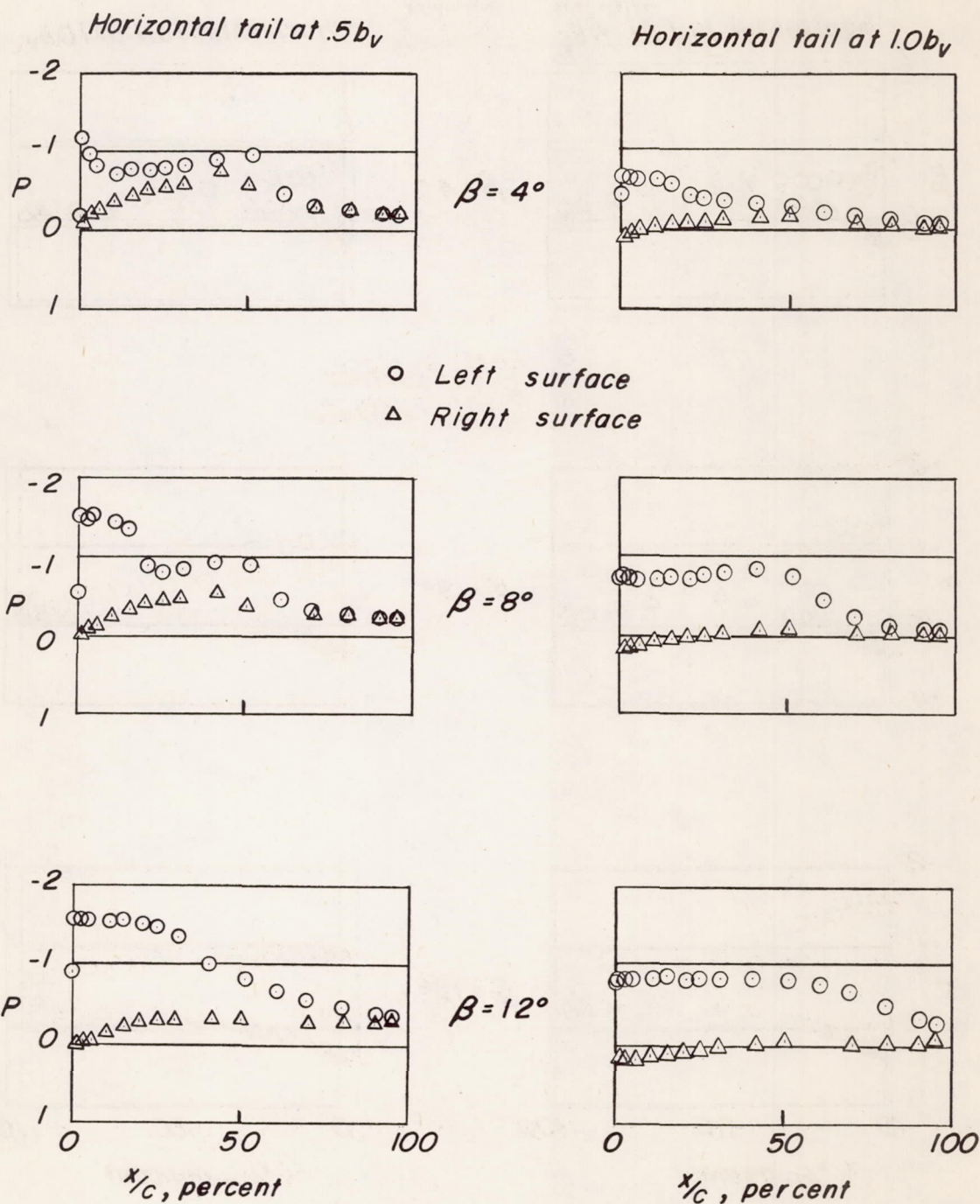
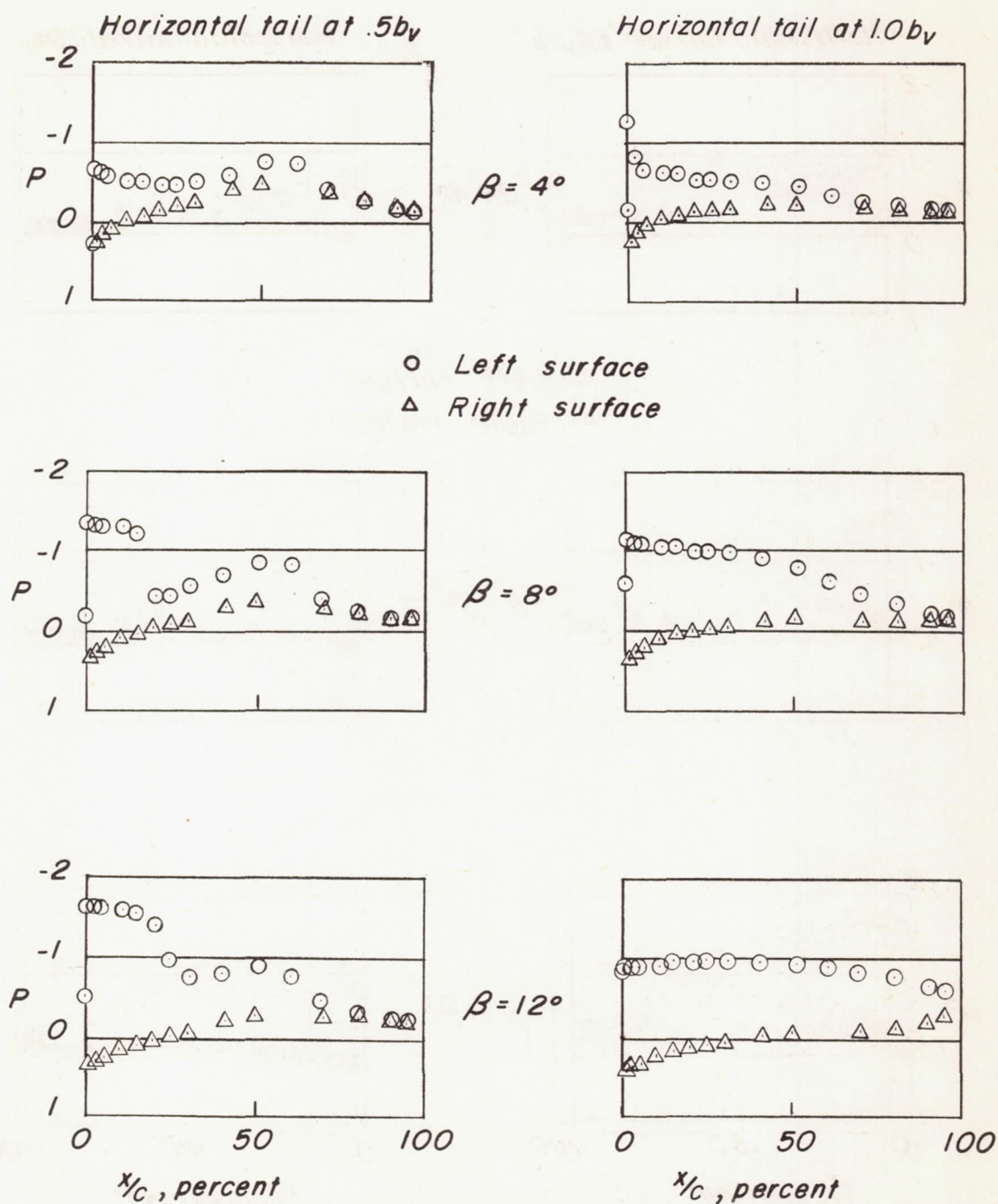
(b) $\alpha = 12^\circ$.

Figure 20.- Concluded.



(a) $\alpha = 0^\circ$.

Figure 21.- Pressure distribution on vertical tail. Span station 0.560;
 $M = 0.85$.

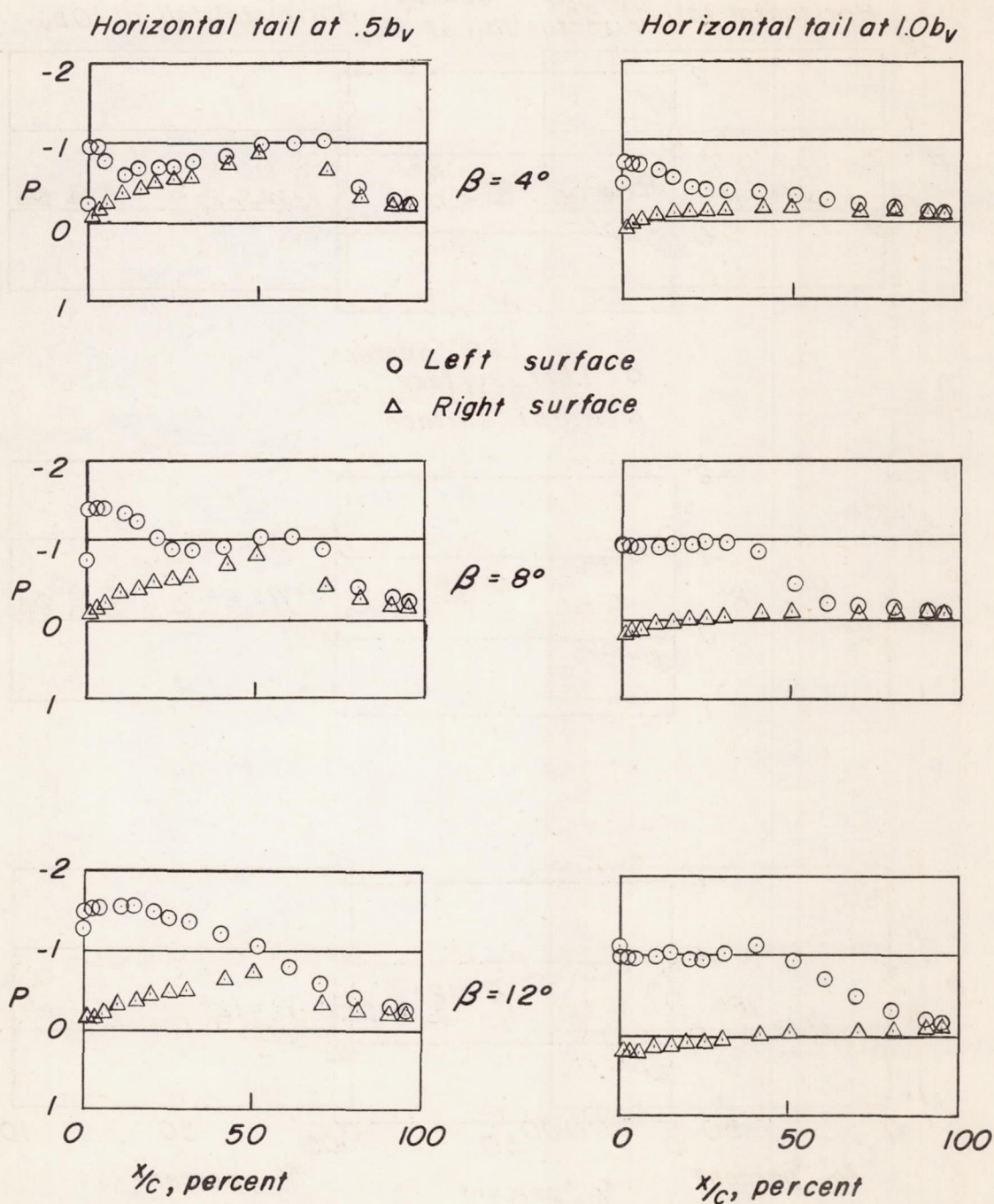
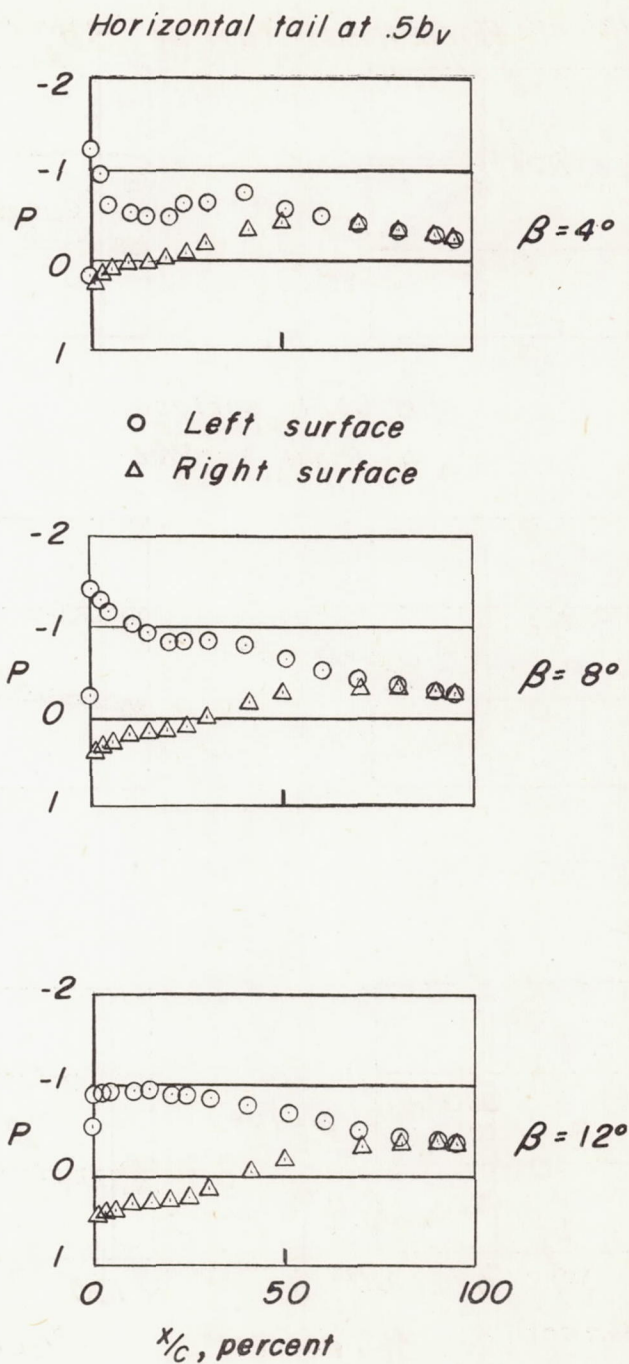
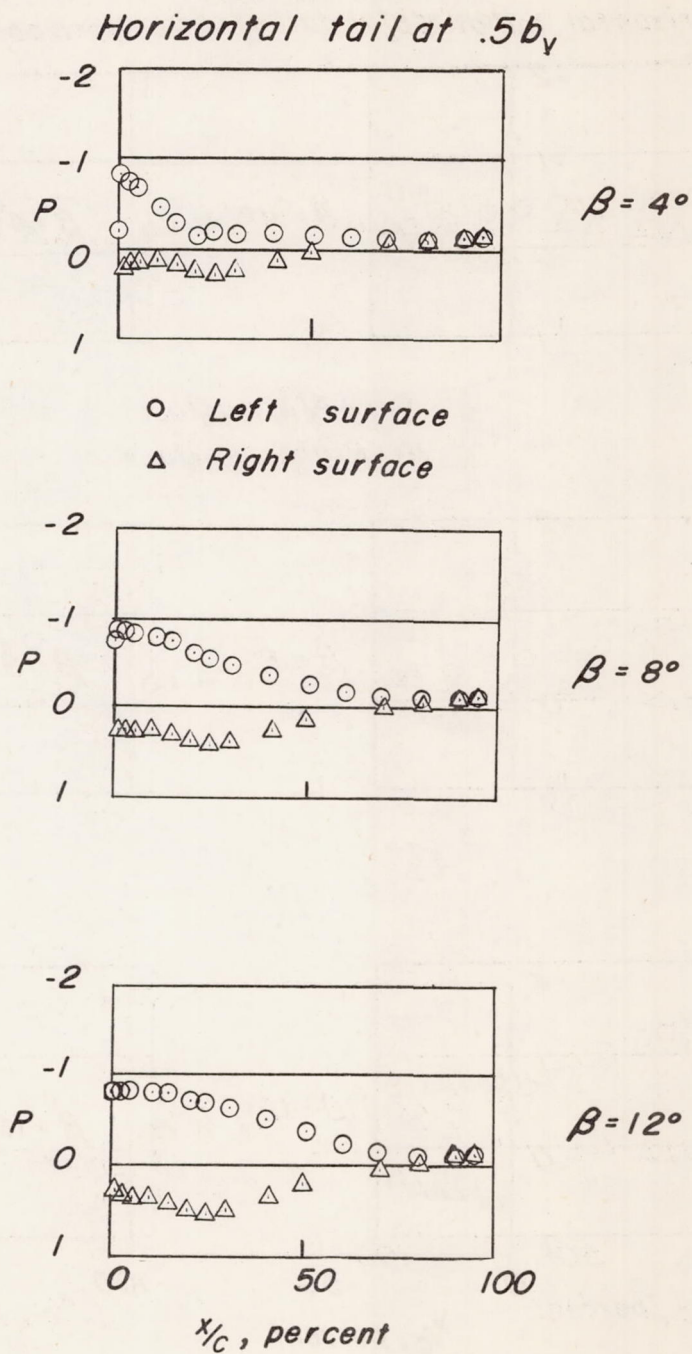
(b) $\alpha = 12^\circ$.

Figure 21.- Concluded.



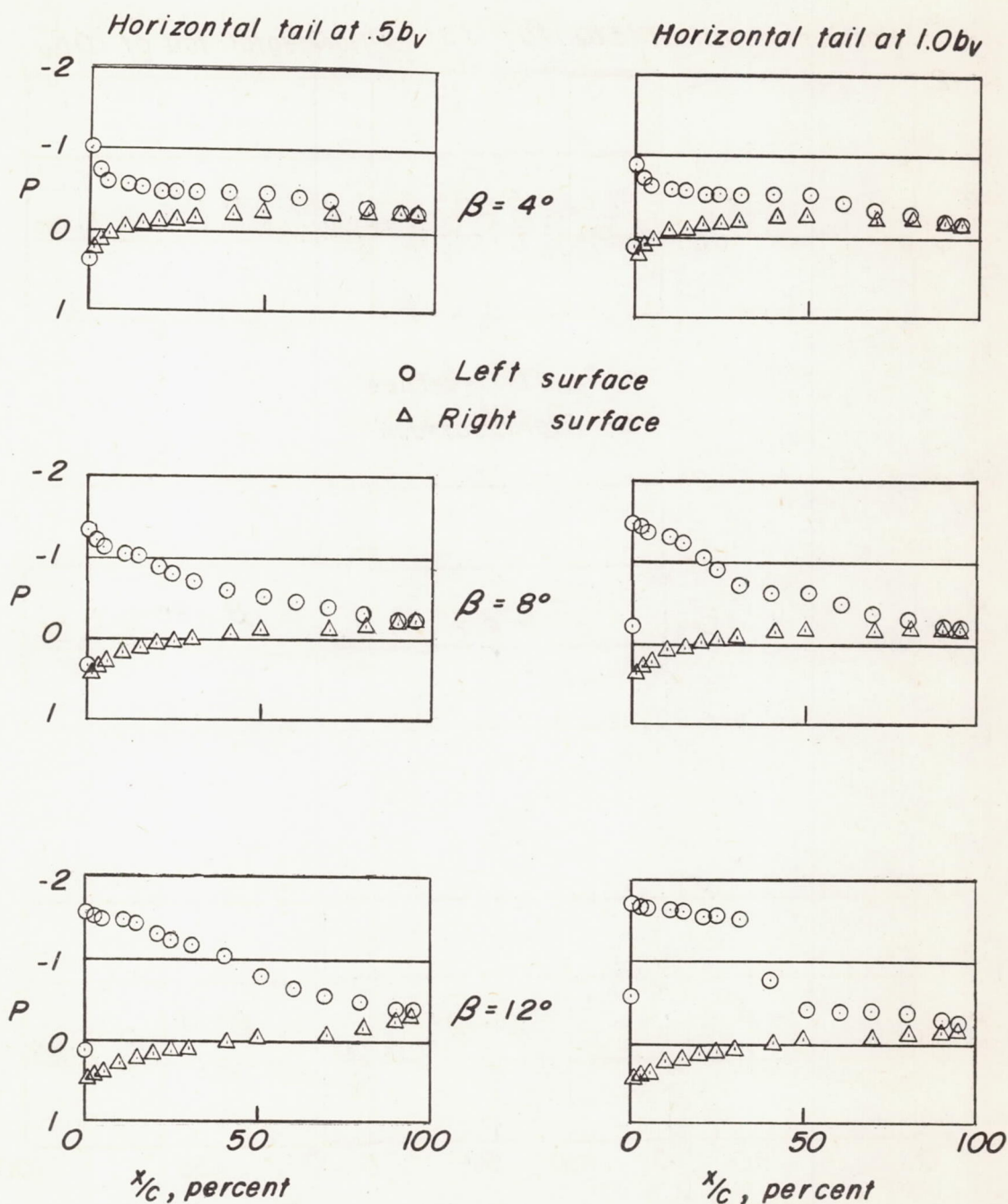
(a) $\alpha = 0^\circ$.

Figure 22.- Pressure distribution on vertical tail. Span station 0.450;
M = 0.85.



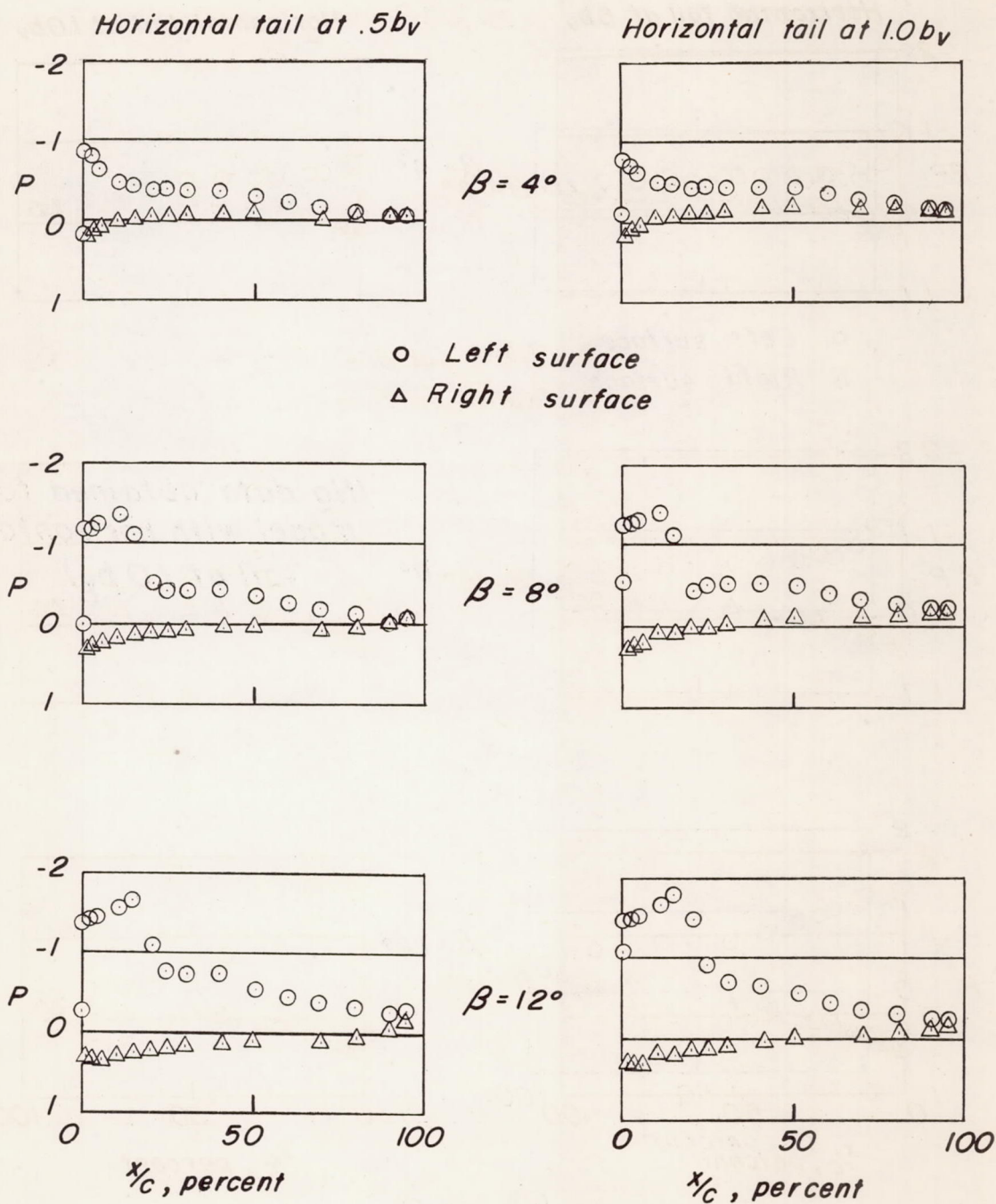
(b) $\alpha = 12^\circ$.

Figure 22.- Concluded.



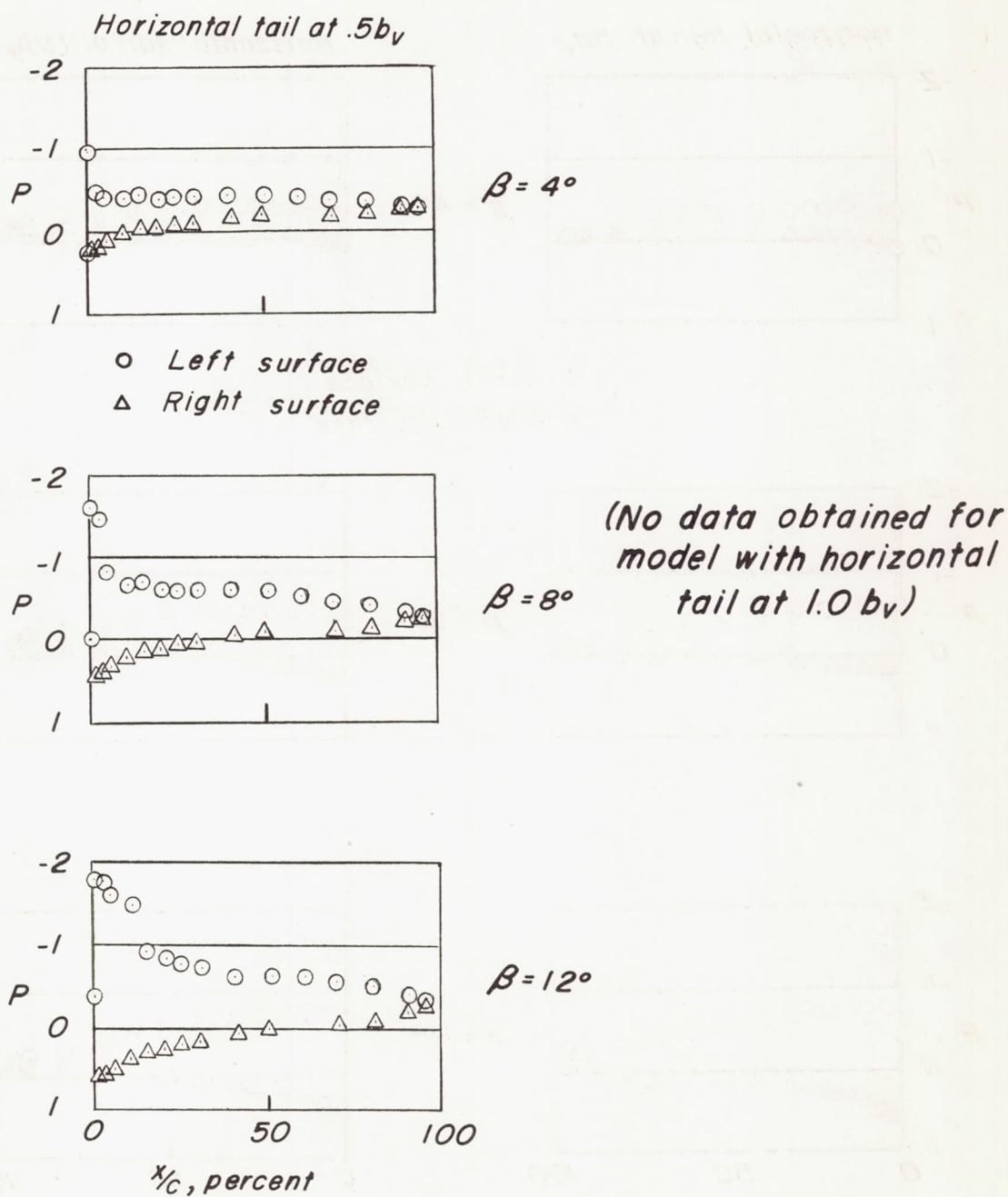
(a) $\alpha = 0^\circ$.

Figure 23.- Pressure distribution on vertical tail. Span station 0.300;
 $M = 0.85$.



(b) $\alpha = 12^\circ$.

Figure 23.- Concluded.



(a) $\alpha = 0^\circ$.

Figure 24.- Pressure distribution on vertical tail. Span station 0.200;
 $M = 0.85$.

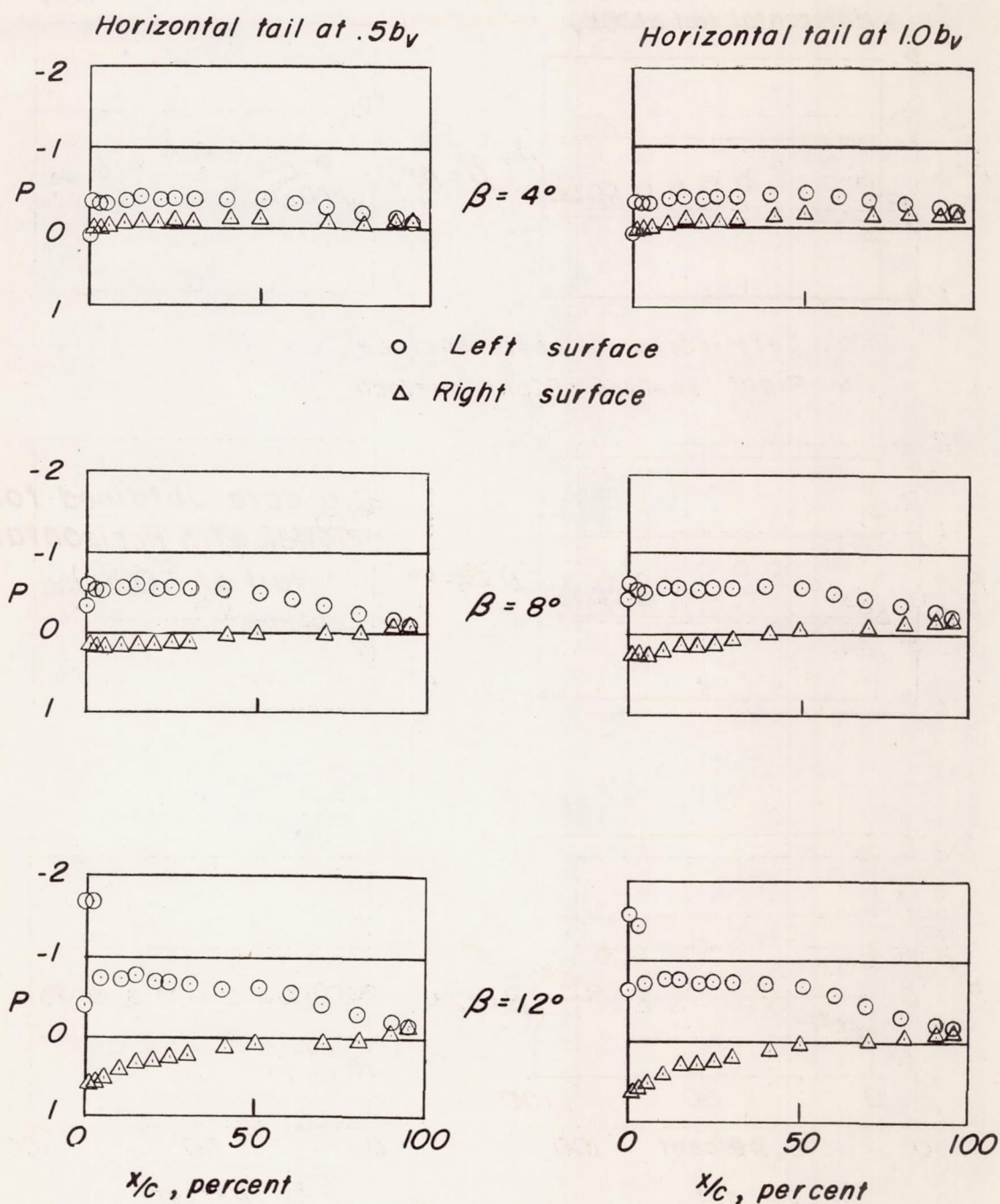
(b) $\alpha = 12^\circ$.

Figure 24.- Concluded.

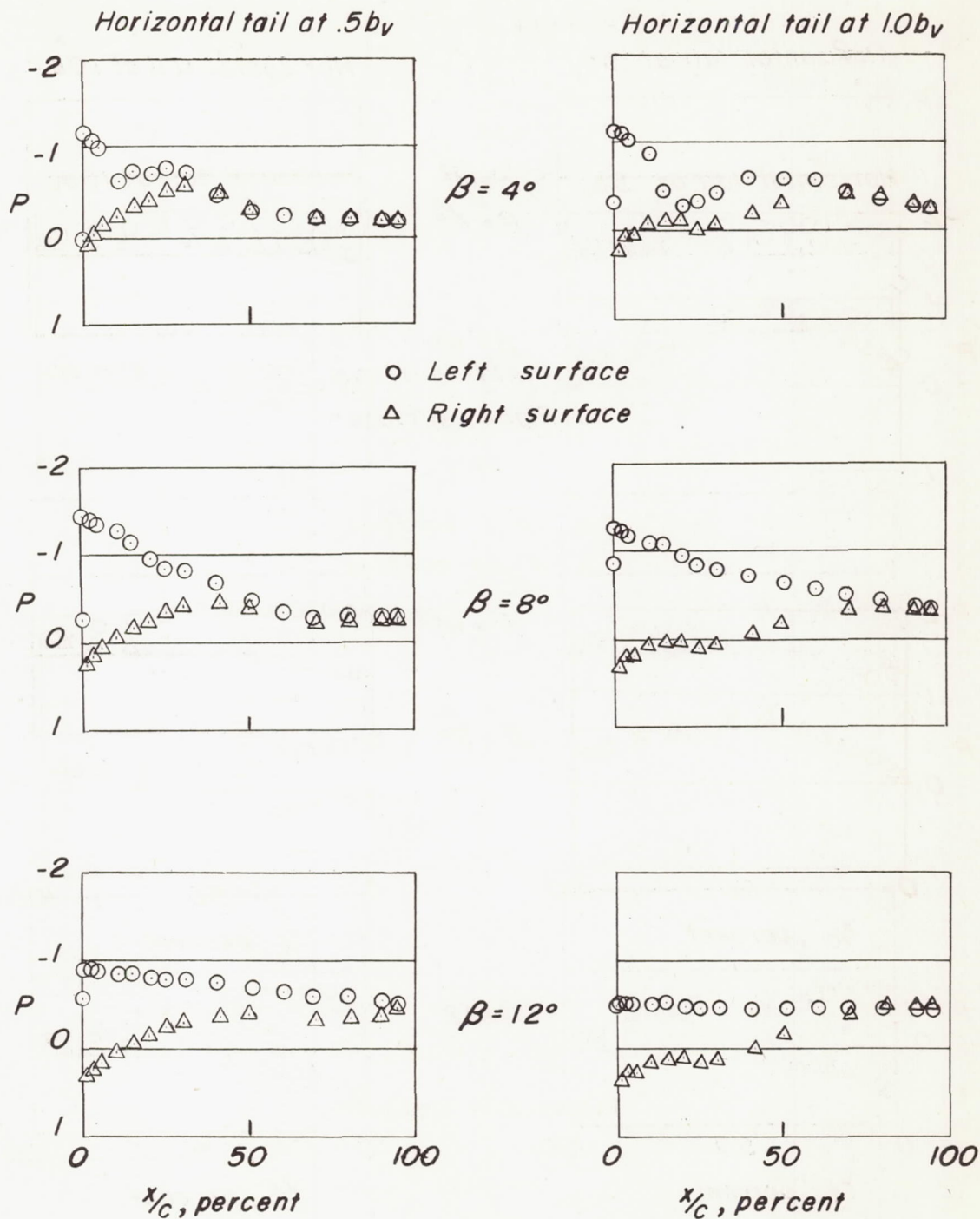
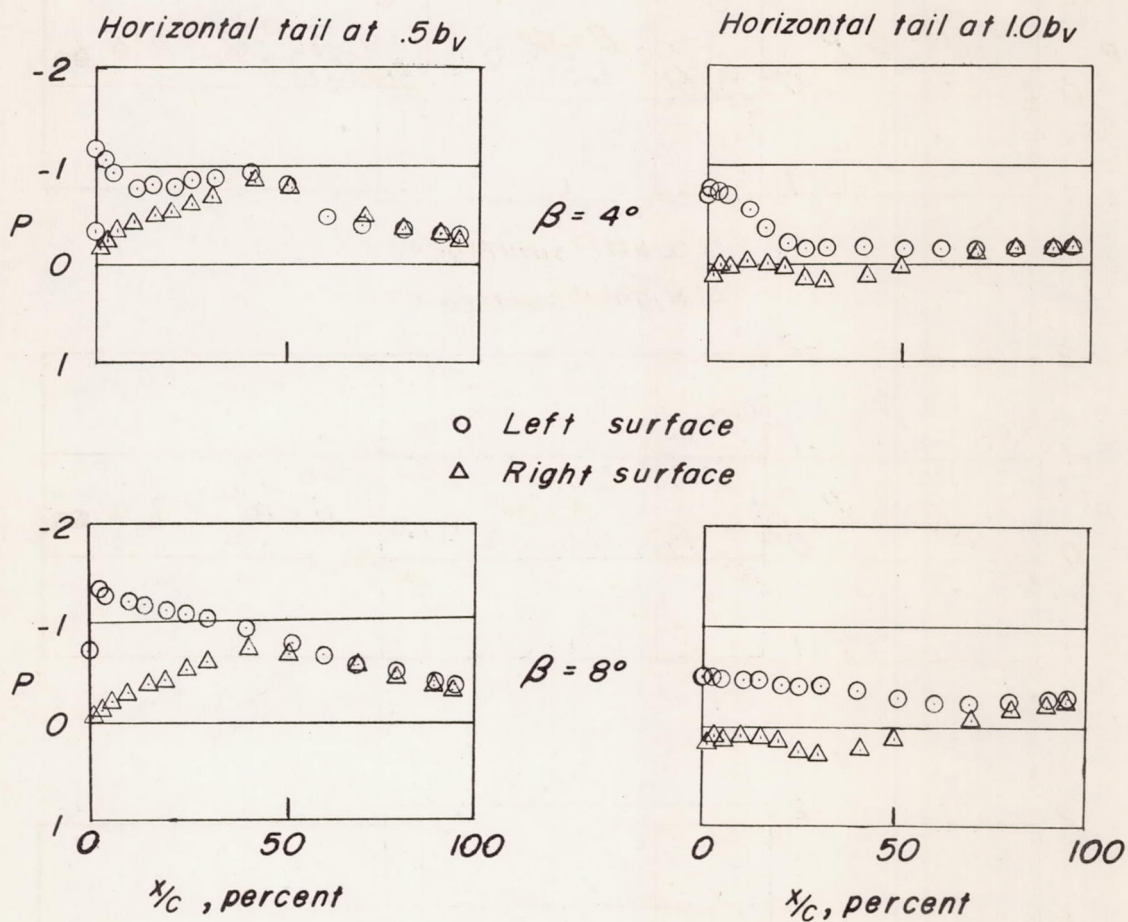
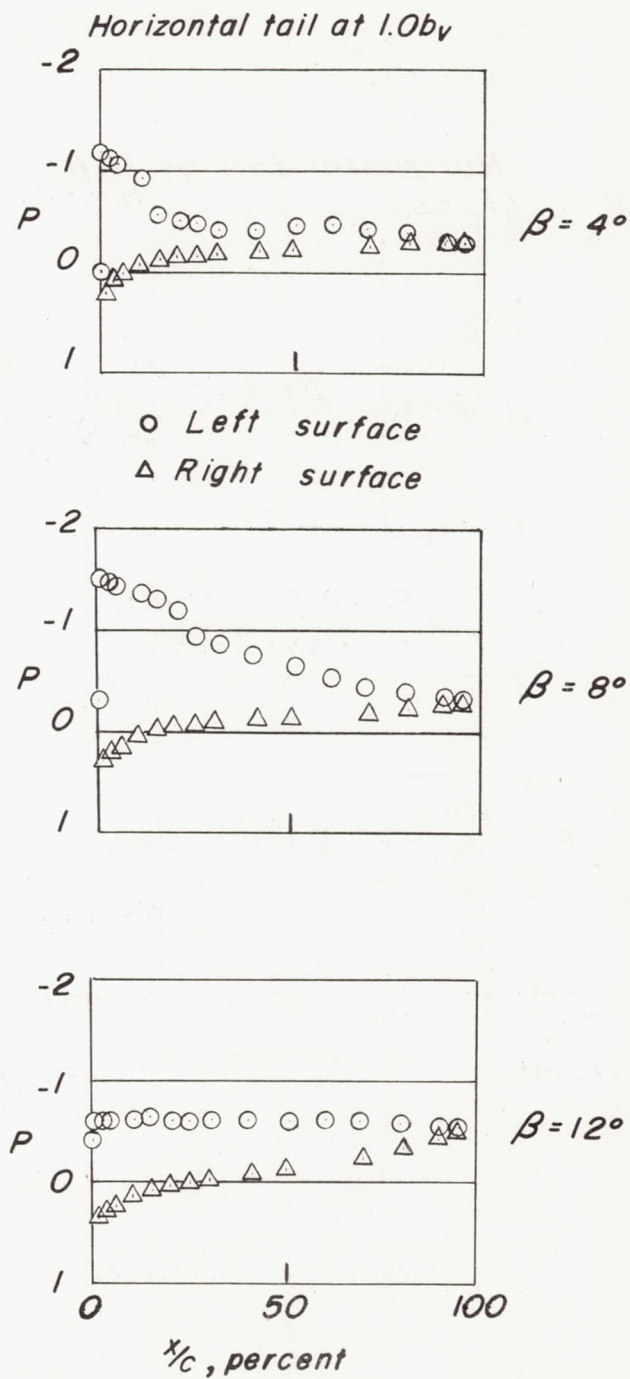
(a) $\alpha = 0^\circ$.

Figure 25.- Pressure distribution on vertical tail. Span station 0.931;
M = 0.95.



(b) $\alpha = 12^\circ$.

Figure 25.- Concluded.



(a) $\alpha = 0^\circ$.

Figure 26.- Pressure distribution on vertical tail. Span station 0.850;
M = 0.95.

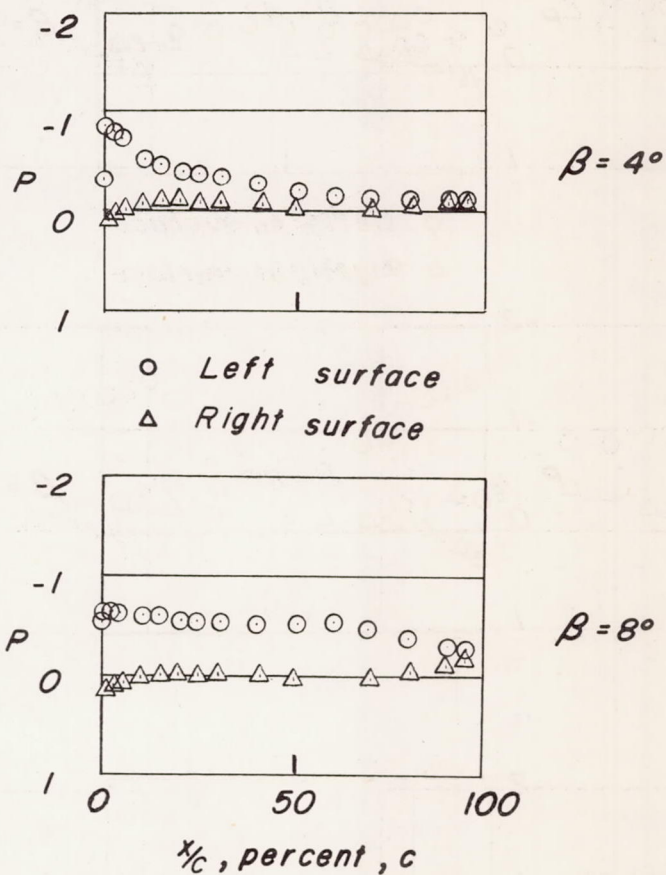
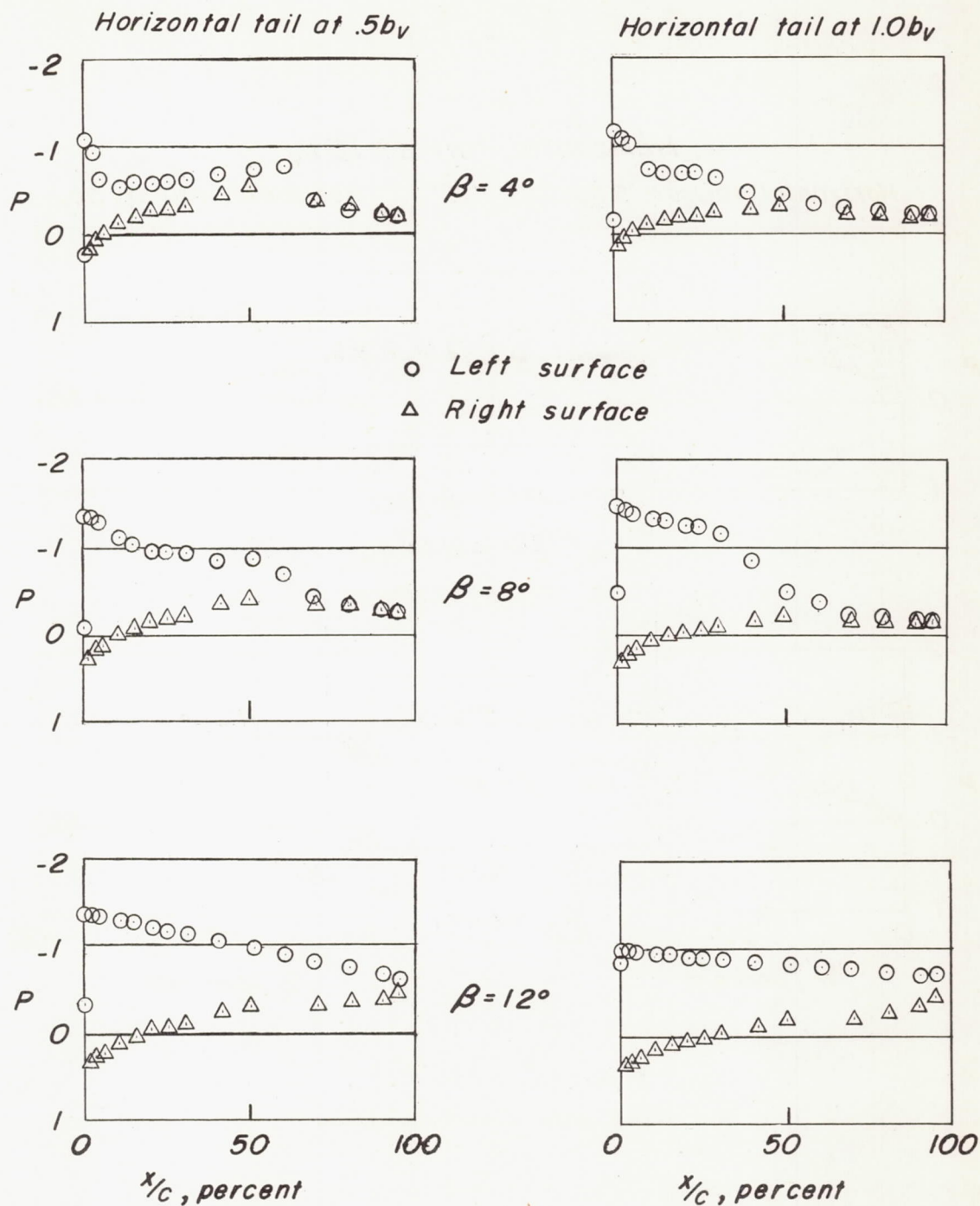
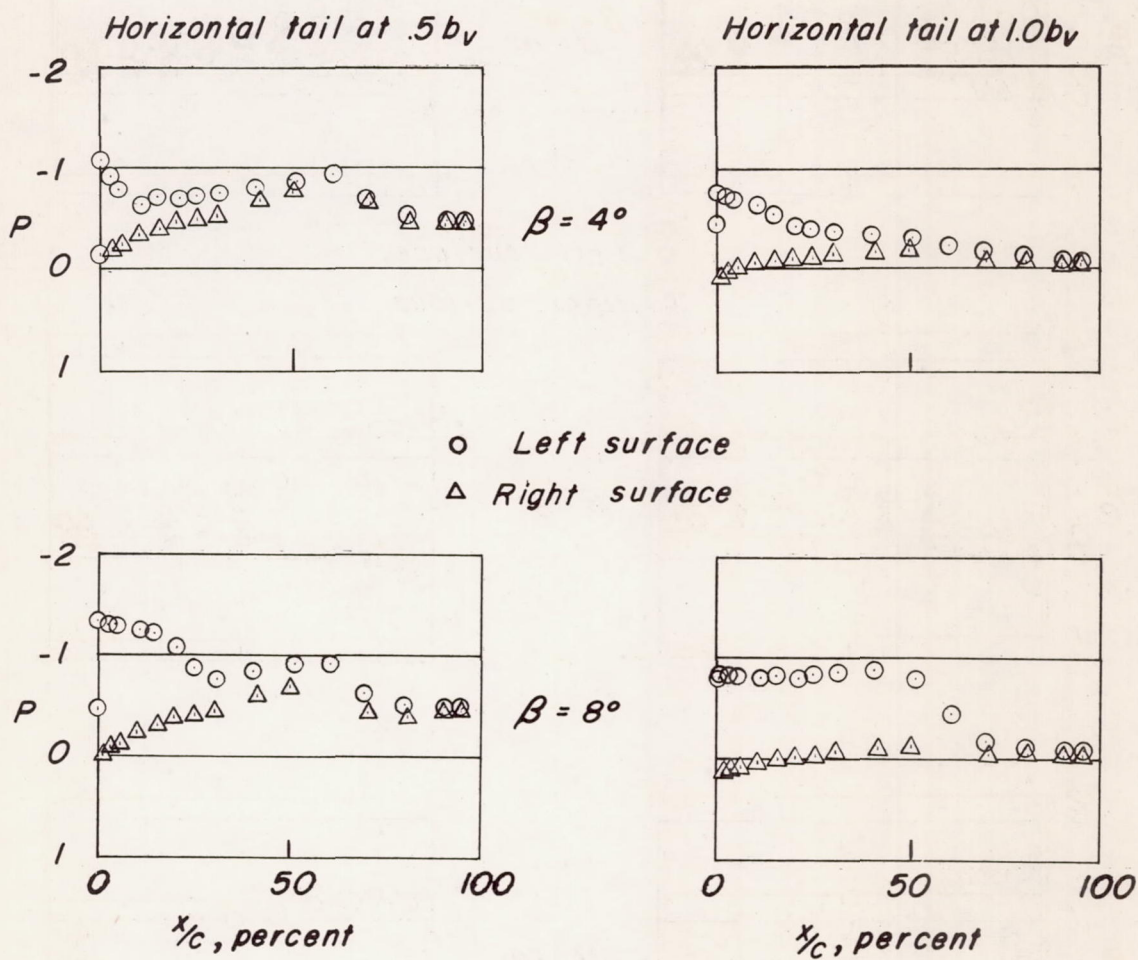
Horizontal tail at $1.0b_v$ (b) $\alpha = 12^\circ$.

Figure 26.- Concluded.



(a) $\alpha = 0^\circ$.

Figure 27.-Pressure distribution on vertical tail. Span station 0.700;
 $M = 0.95$.



(b) $\alpha = 12^\circ$.

Figure 27.- Concluded.

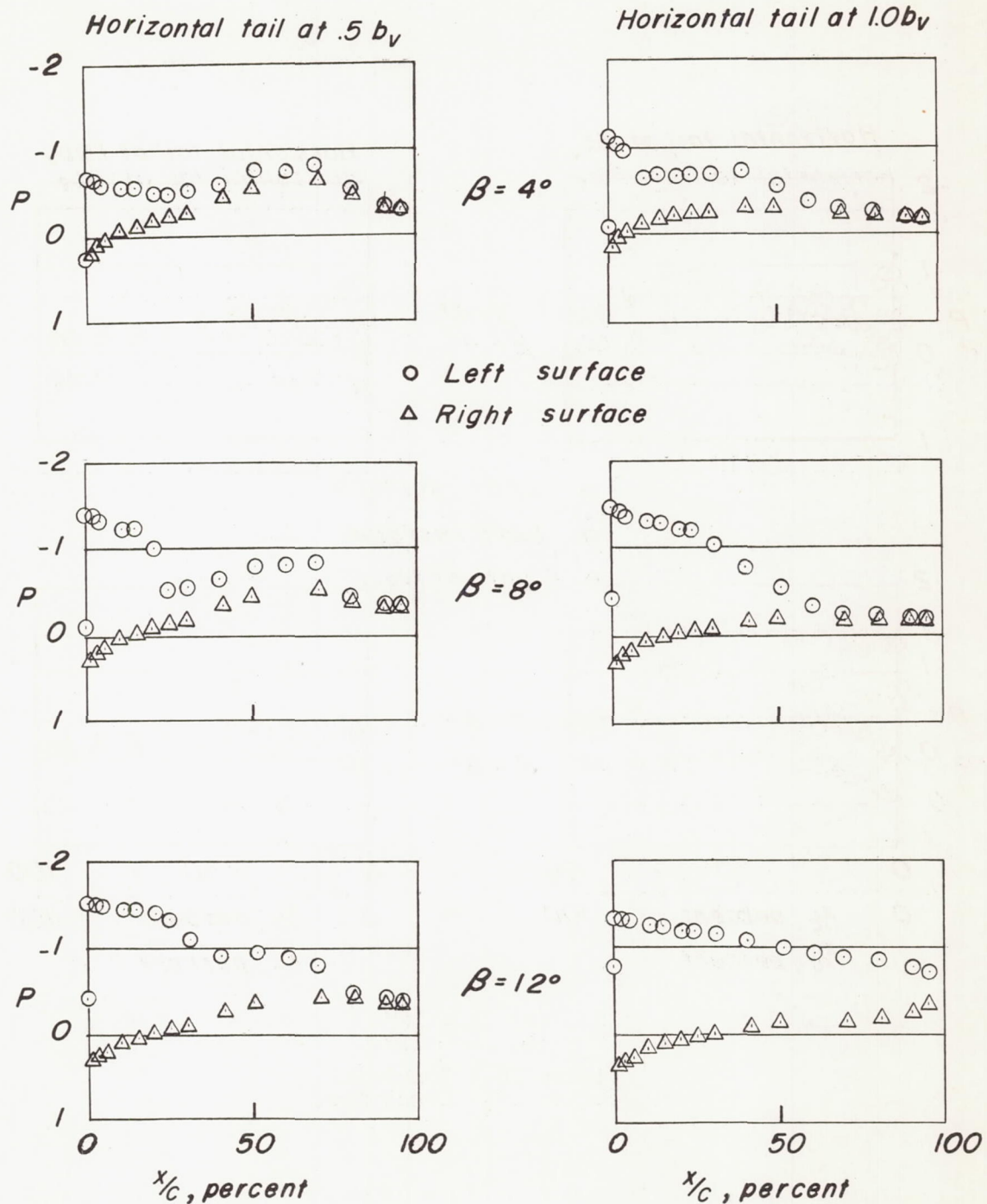
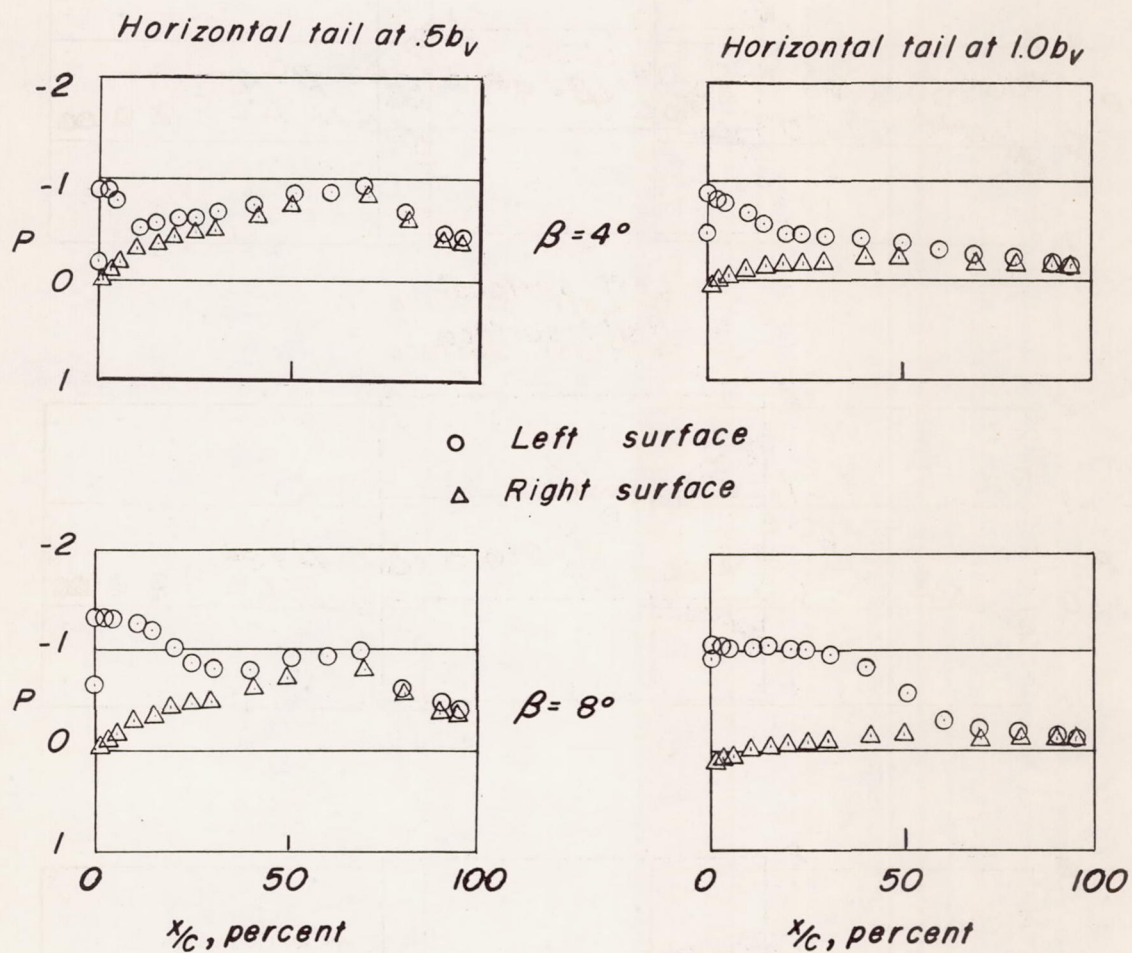
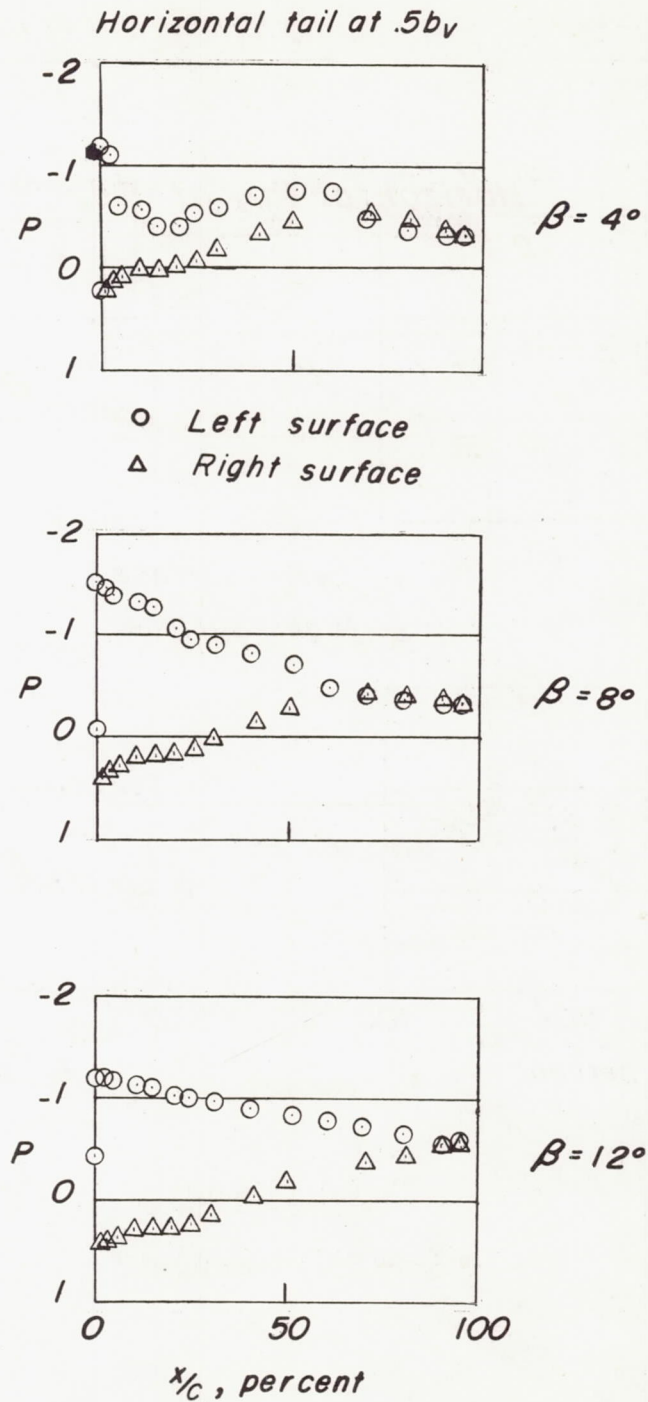
(a) $\alpha = 0^\circ$.

Figure 28.- Pressure distribution on vertical tail. Span station 0.560;
 $M = 0.95$.



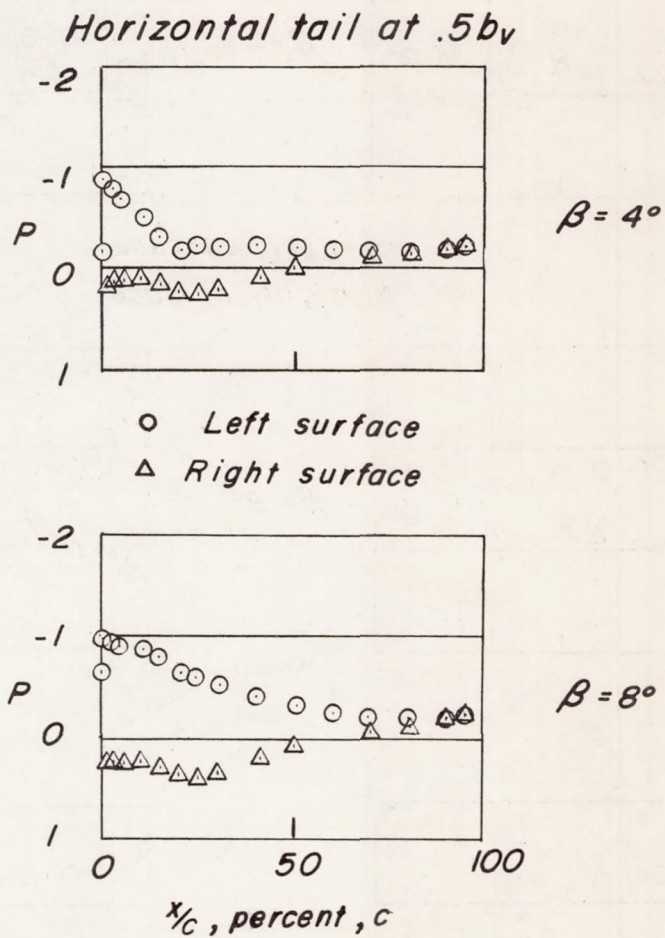
(b) $\alpha = 12^\circ$.

Figure 28.- Concluded.



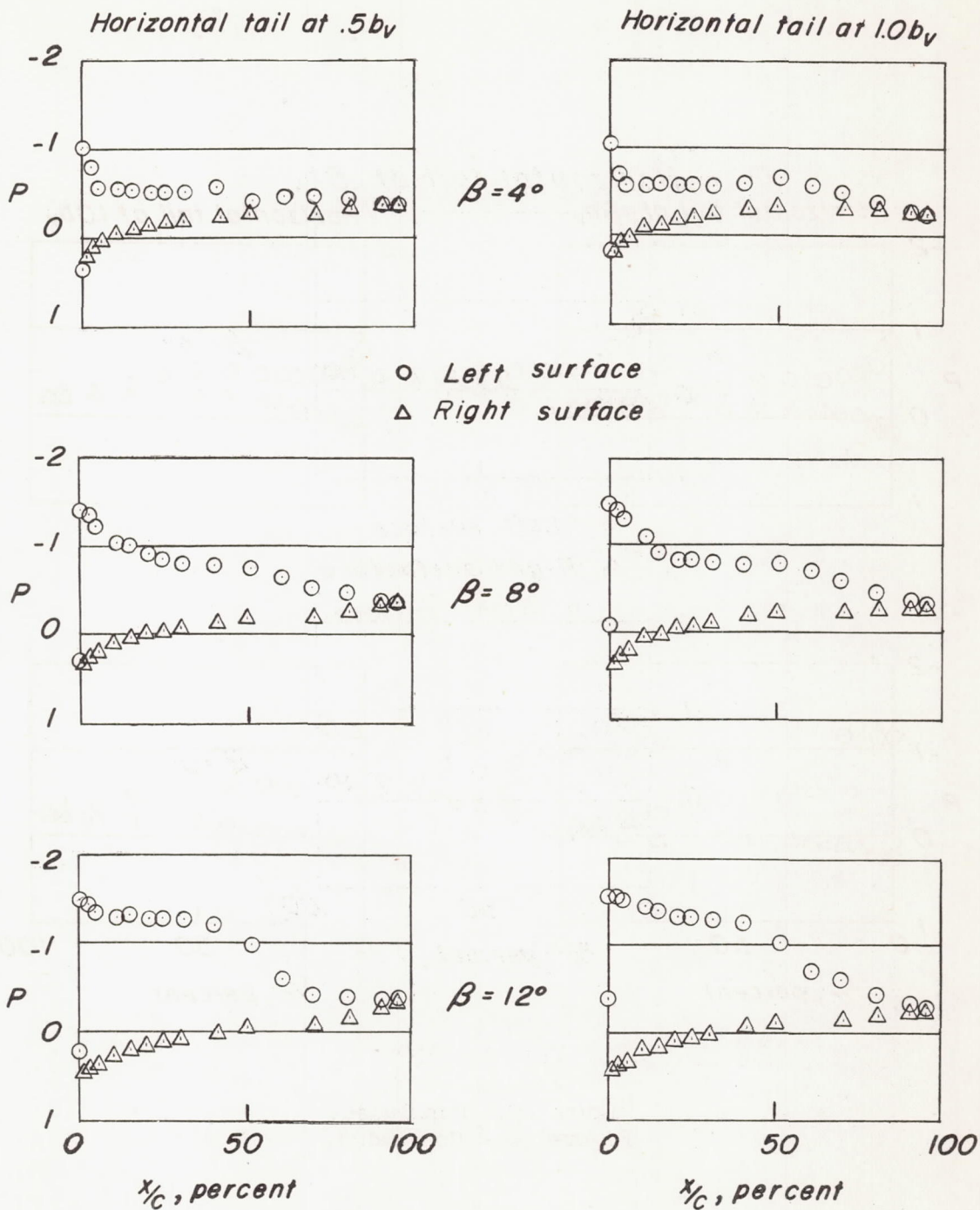
(a) $\alpha = 0^\circ$.

Figure 29.- Pressure distribution on vertical tail. Span station 0.450;
M = 0.95.



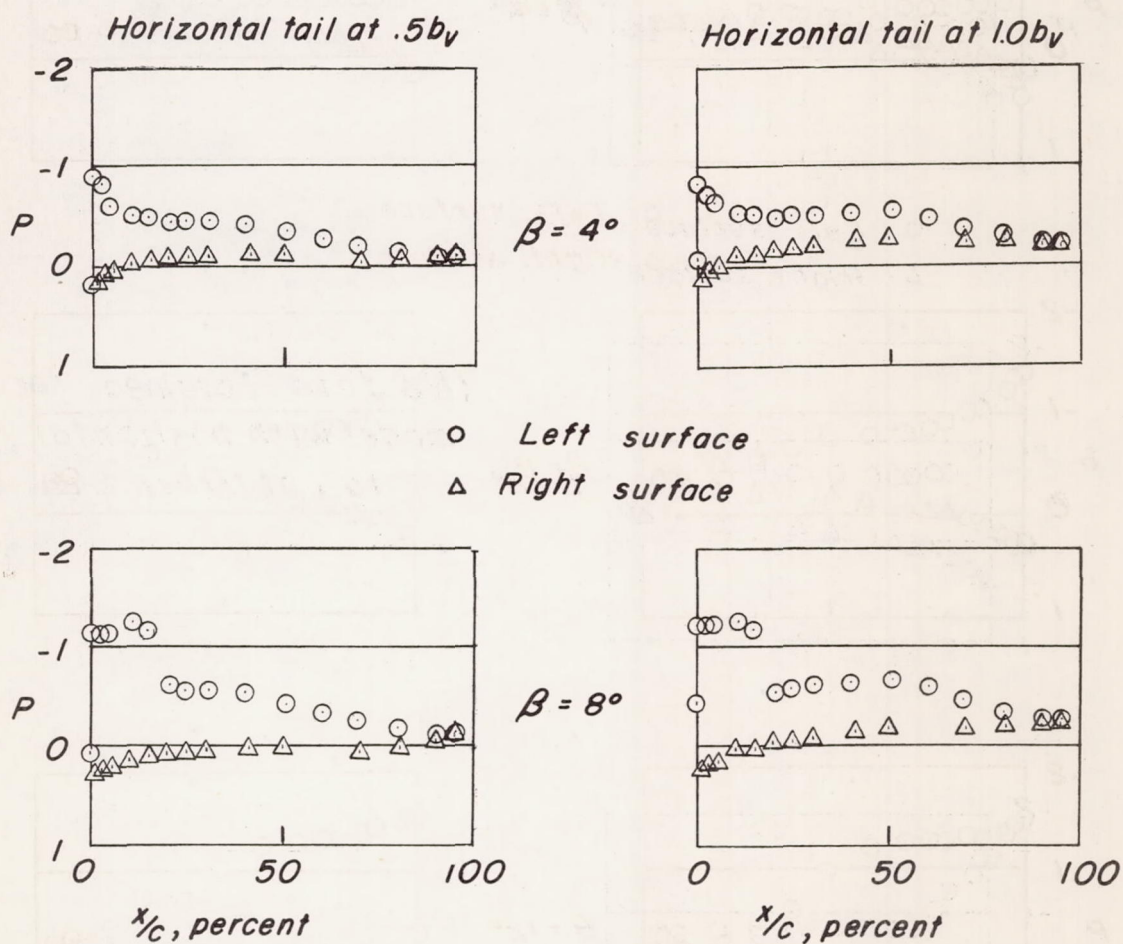
(b) $\alpha = 12^\circ$.

Figure 29.- Concluded.



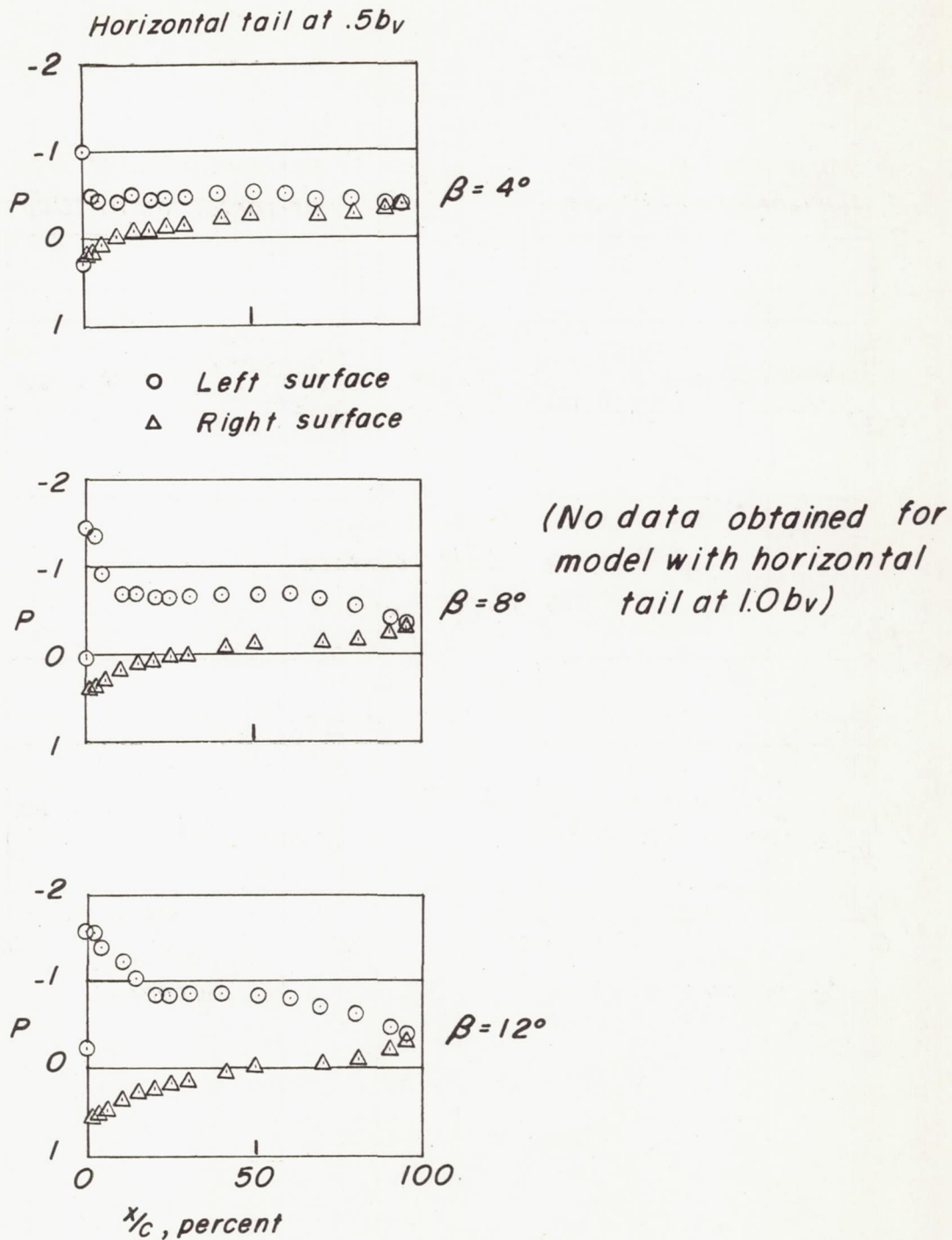
(a) $\alpha = 0^\circ$.

Figure 30.- Pressure distribution on vertical tail. Span station 0.300;
 $M = 0.95$.



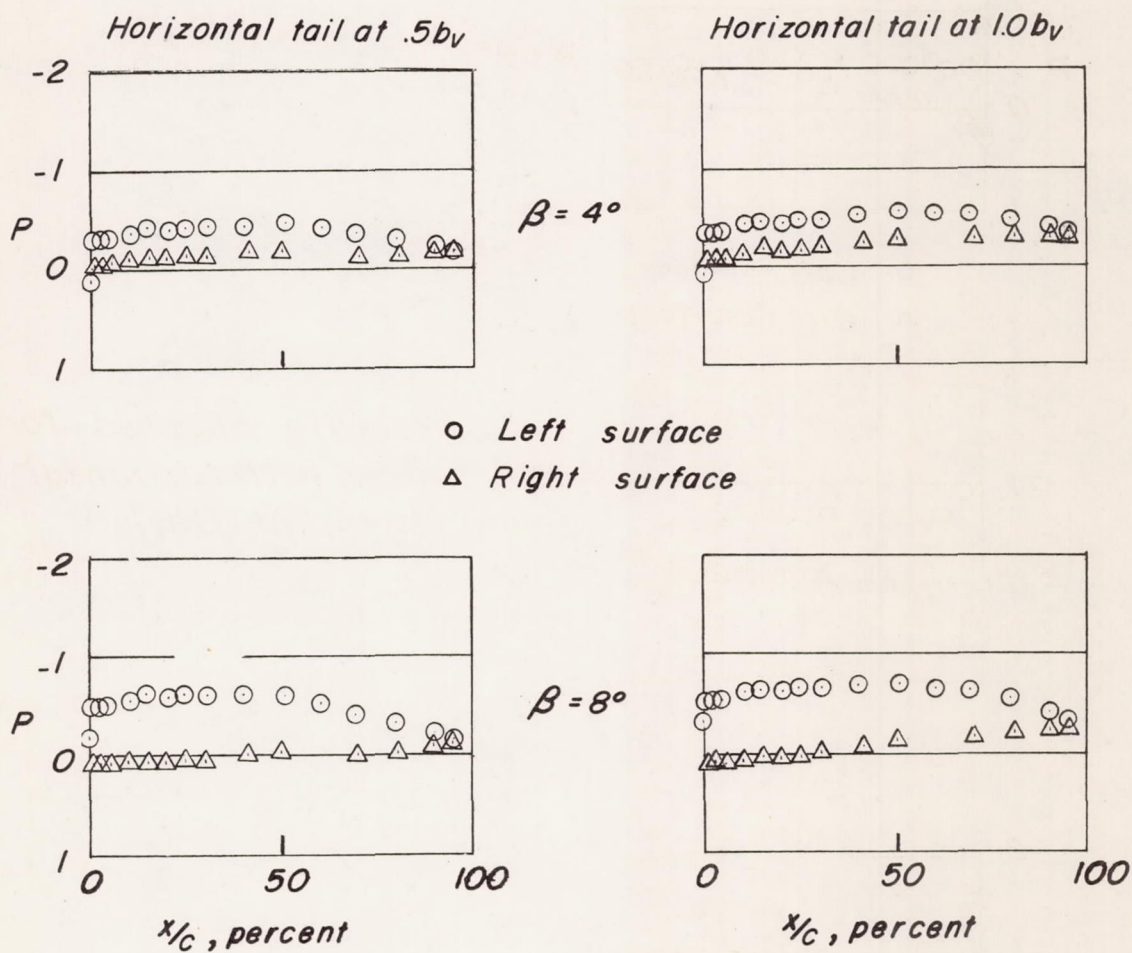
(b) $\alpha = 12^\circ$.

Figure 30.- Concluded.



(a) $\alpha = 0^\circ$.

Figure 31.- Pressure distribution on vertical tail. Span station 0.200;
M = 0.95.



(b) $\alpha = 12^\circ$.

Figure 31.- Concluded.